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THE ABSCESS OF POTT'S DISEASE

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THE subject of tuberculosis of the spine is a very old one. Much has been written on the clinical and roentgenological findings, but in most of this writing only casual mention has been made of the abscess accompanying Pott's disease. The growing conviction that the abscess associated with Pott's disease has been neglected in such studies has prompted the writing of this paper. The author working with Bradley[1] studied a series of films of cases of tuberculosis of the spine at the New England Peabody Home for Crippled Children. A further review of this same group of cases and observations on numerous other cases have made up the basic material for this paper. Our clinical examinations often fail to reveal abscesses of considerable size in Pott's disease. Too often we fail to notice the abscess in the iliac fossa until it has become very large. The roentgenological examination should and will reveal many of these abscesses. It is not necessary to emphasize the importance of good films. With good roentgenograms, however, much more can be read into the interpretation than a simple statement of the presence of a destructive lesion in the spine. In many cases we can fairly accurately prognosticate the future of the case, and such prognosis depends largely on the type, size, and course of the abscess.

The abscess we are interested in is not the unruptured abscess present beneath the skin in the groin or in other places ready for puncture, but the deep abscess often not diagnosed clinically but seen first in the roentgenogram. We feel quite strongly that the abscess is as important a part of the roentgenogram as the lesion itself, and that careful observation of these abscesses and their behavior as seen in the film will lead to a better understanding of their significance. The purpose of this paper is to stimulate such an interest, particularly among those more interested in the roentgenograms.

Such abscesses as seen by us are the most important complications of tuberculosis of the spine. We believe that the behavior of the abscess to a certain degree forecasts the behavior of the diseased spine and perhaps to a greater extent the ultimate welfare of the individual. That the abscess in its behavior varies greatly in thoracic Pott's disease and in lumbar Pott's disease we wish to emphasize. This behavior is directly due to the variations in the anatomical structure of these two regions.

THE THORACIC ABSCESS

In the thoracic spine we have heavier anterior longitudinal and lateral ligaments.[2] These are held firmly attached to the bone, above at the base of the neck by the insertions of the neck muscles, below by the attachments of the pillars of the diaphragm. In disease of the thoracic spine

the pus collects beneath the periosteum of the vertebral bodies and the anterior and lateral longitudinal ligaments. Unfortunately there is no exit for it except to pass along beneath these ligaments burrowing its way from vertebral body to vertebral body until we have an abscess sac of considerable size formed around the vertebral bodies and lying behind the aorta. The aorta is of course elastic to a degree, but being held more or less bound down to the thoracic spine by the intercostal arteries, there must be transmitted to this sac some of the pulse waves from the aorta. These in turn must be transmitted to the bony substance of the vertebrae, and they in turn being denuded of their periosteal blood supply suffer an actual loss of substance. This condition, from the roentgen-ray standpoint similar in many respects to the erosion of an aneurysm, is seen not infrequently in these cases of thoracic Pott's disease. It is of course more easily demonstrated in the lateral roentgenogram (Fig. 1), but for proper estimation of the possible extent of this erosion due to the abscess and for estimation of the size of the abscess an anteroposterior view is essential (Fig. 2). The paravertebral shadows are sometimes confusing. Kankeleit[3] discusses shadows along the vertebrae normally present, and according to him these are due to lung and pleura. We believe that early abscesses of the type we are describing could be so flat along the vertebrae as to give roentgen shadows that might be confused with those described by Kankeleit. On the other hand, in most of the known advanced cases, and these are the ones we recognize, it is not very difficult to outline the abscess.

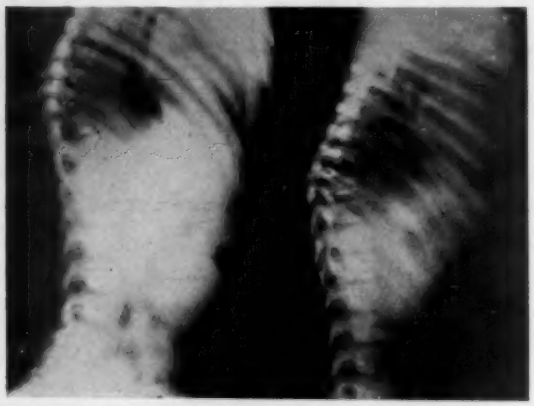


FIG. 1. a. Lateral roentgenograms of spine with fusiform abscess showing the erosion of the anterior portion of five bodies above and one below the primary lesion, taken during first year of observation. The discs remain intact suggesting what we have termed mechanical erosion.

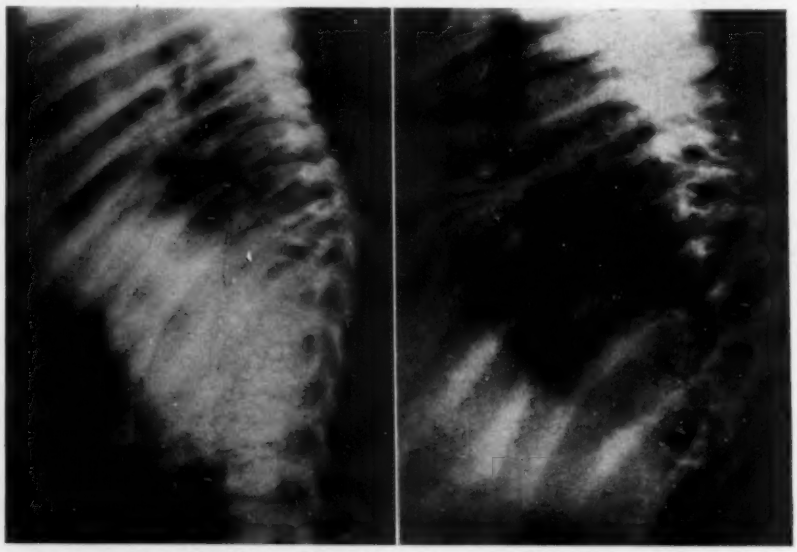


FIG. 1. b. Same case a year later. Condition about the same.

FIG. 1. c. Same case at the end of two years showing more extensive destruction with evidence of disappearance of some of the discs. This seems to us to indicate inflammatory erosion.

In a previous paper[1] we described three

types of abscess—the fusiform, the pyramidal, and the globular. Further observation has not changed this classification. From the standpoint of prognosis and clinical significance the pyramidal and fusiform abscesses are essentially the same. The globular is of distinctly different significance. The two former types represent, as a rule, fairly widespread dissection of the spinal column. This to my mind signifies greater resistance in the ligaments attached to the spinal column so that there is a more widespread dissection of the vertebrae themselves. The latter type in most cases represents a less resistant set of ligaments which either break through allowing the abscess to form outside the ligamentous structure or which stretch

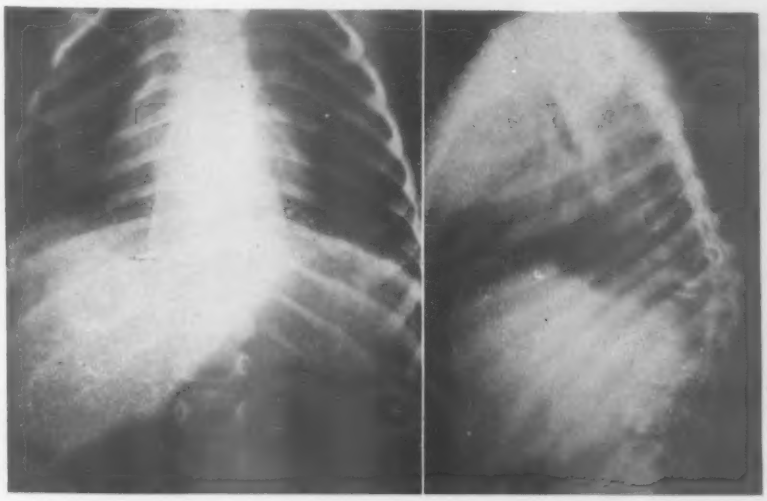


FIG. 2. a. A case of thoracic Pott's disease with "pyramidal" type of abscess. The extent of the abscess corresponds to the erosion seen in b.

FIG. 2. b. Lateral view showing erosion of the anterior portion of the bodies of six vertebrae above the primary lesion. There is some calcification of the contents of the abscess which shows rather clearly.

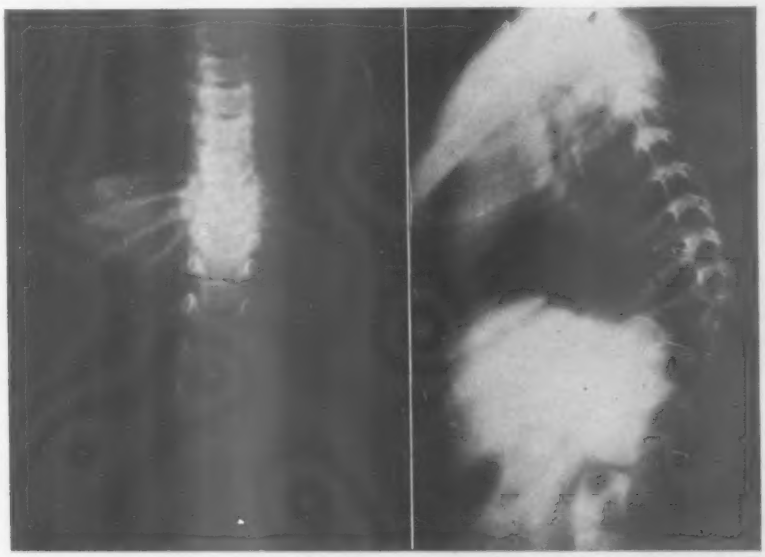


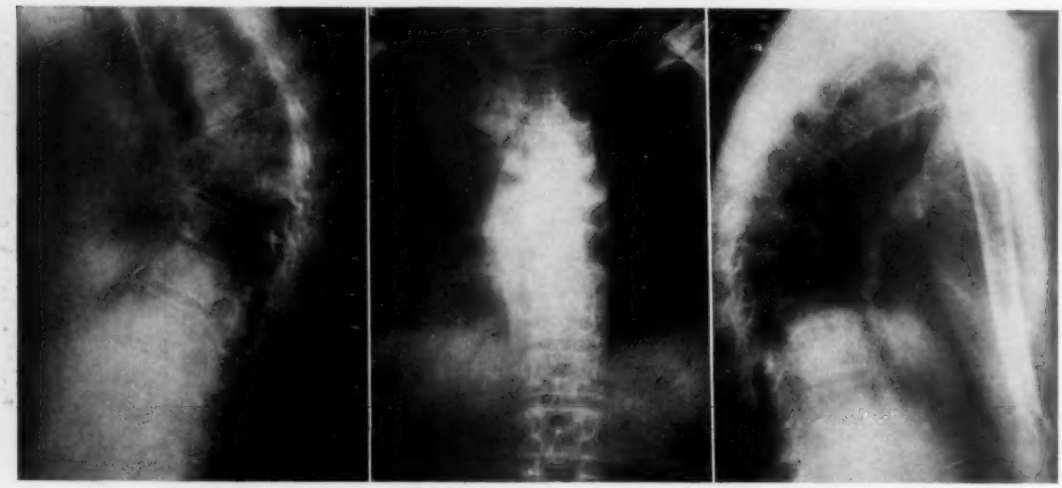
FIG. 2. c. Anteroposterior view one year later showing almost complete disappearance of the abscess. Calcification is visible.

FIG. 2. d. Lateral view shows the diminution in the size of the abscess and some increase in the amount of calcification. There has been no increase in the amount of erosion of the adjacent vertebrae.

over the area affected and so prevent the dissection seen in the more resistant cases represented by the fusiform and pyramidal types of abscess. From our observations on these cases over a period of years we are quite convinced that with the globular type of abscess we do not as a rule see the extensive involvement seen with the pyramidal and fusiform types. We do see, from time to time, cases with two or more of these abscesses, and we have seen on some occasions abscesses of the fusiform as well as the globular type in the same case. The latter in these cases are usually offshoots or by-products of the original abscess and do not then have the same significance as when present alone. We have therefore come to feel that the globular type of abscess foretells a better course; that the pus instead of dissecting and burrowing its way along the spinal column works its way laterally and so far as damage to the vertebrae is concerned, other than those originally involved, there is little damage done.

On the contrary, the pyramidal and fusiform types represent extensive dissection beyond the region of the original focus, and the vertebrae thus exposed may number anywhere from one to six or even more, besides the area which we speak of as the original focus. In some of these cases the erosion is smooth in outline with the discs remaining intact, as evidenced by a narrow strip of bone showing in the roentgen film along the disc margin. This type of erosion is exactly similar to that seen in association with aneurysms of the aorta. We have the bony erosion due to the pulsing tumor, and the discs which are usually elastic and thus not affected by a pulsating force remain entirely intact. Such extension seems to us possibly almost entirely due to the mechanical forces present. There are of course others in which the mechanical type of extension is probably less important than the inflammatory. However, from our knowledge of cold abscesses associated with Pott's disease, we must admit that purely mechanical factors ofttimes play a large part in their extension.

It is these mechanical factors which we wish to emphasize as of necessity playing some part in the formation of these lesions. That the roentgen-ray appearance of some cases is similar in many respects to that of a spine showing bony erosion due to an aortic aneurysm is clear. That the same mechanical factors exist in these



a b c

FIG. 3. a. Tuberculosis of thoracic spine in a male aged fifty-eight. Note destructive lesion involving three vertebrae.

b. Anteroposterior view showing abscess of fusiform type. Note extension of abscess over the entire thoracic spine.

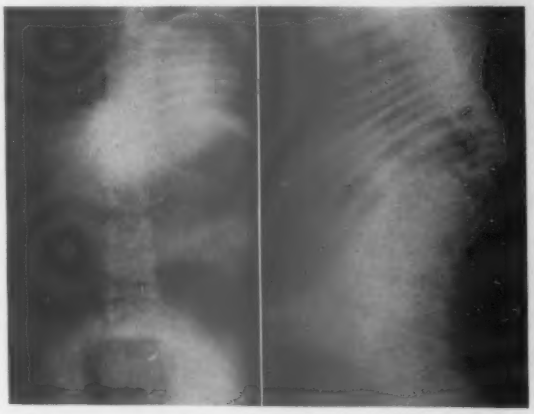
c. Lateral view one year later. A secondary focus has developed below the original lesion.

cases is likewise clear. That up to a certain point the mechanical forces play a considerable part is to us a logical conclusion.

The three types of abscess are not definitely clean cut. As we have already indicated, fusiform and globular types may exist in the same case, and again, we may see extensive involvement present in a very large globular abscess. Or we may see a globular type of abscess of moderate size present in an old case with extensive destruction. In all such cases where we have been able to find the early films we can demonstrate a dissecting abscess of the fusiform or pyramidal type early in the disease later receding or draining its contents into the globular abscess. As a general rule, however, the small globular abscess foretells little trouble, while the fusiform type means a long drawn out process with extensive dissection of the vertebrae and ultimately much destruction. This of course results invariably in a large kyphosis (Fig. 4).

We have dwelt at length on the mechanical influences at play in the formation of these abscesses. We do not mean to give the impression that the mechanical factors are the only ones at work or that they are the most important. On the other hand, these mechanical forces are probably in the majority of cases of secondary importance to the actual inflammatory or ulcerative process. Ménard[4] in his classical work on this subject describes and illustrates abscesses of all types and of great extent. He further points out that there are two types of destruction, mechanical and ulcerative. He regards the mechanical as only taking place after the kyphos has formed and as erosion due to actual attrition of one vertebral body on the other. He believes that the spread of the abscess beneath the ligaments is due entirely to an ulcerative or inflammatory process. Others who have written on this subject regard this extension as inflammatory, notably Nichols[5] who described the process as inflammatory, and Wullstein[6] who regarded this process as due to simultaneous infection of several vertebrae through the blood stream. The latter mentioned the similarity to the appearance of an eroding aneurysm, but did not regard the process as mechanical.

We have examined the specimens of



a b

Fig. 4. a. A case of thoracic Pott's disease with fusiform abscess. (This is not very clearly shown in the reproduction.)
b. Lateral view shows some anterior erosion.

tuberculosis of the spine in the Warren Museum and find among these definite evidence of erosion by both mechanical and inflammatory forces. This was dwelt

F.g. 4. c. Lateral view ten years later showing severe deformity which has developed owing to the extensive destruction of vertebral bodies.

on at some length in our previous paper.[1] Our observations were thus substantiated by pathological specimens.

There are two distinct reasons for the importance of early recognition of these abscesses. In the *first* place such recognition helps materially in establishing a diagnosis of tuberculosis. Unfortunately we do not as a rule see abscess formation till destruction has gone on to an extent great enough to recognize the disease in the lateral roentgenogram, but the occasional case arises when a definitely formed abscess will clinch the diagnosis as tuberculosis. *Secondly*, once recognized the progress of the abscess should be watched most carefully. If it follows a course of progressive enlargement one can expect further destruction of vertebral bodies. If it is already large in size and does not recede one can expect a similar result. On the other hand, recession in size often takes place and with it healing of vertebrae affected may be expected, and at least one can be fairly sure that other vertebrae will not become involved due to the extension of that abscess.

FIG. 5. a. Showing bilateral psoas abscesses in first year of disease.

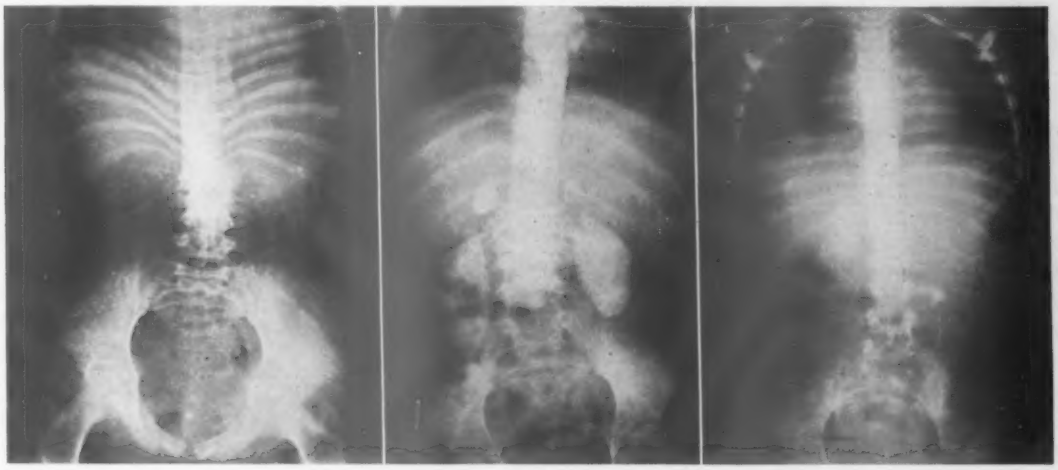
FIG. 5. b. Same case after three years. Abscesses have disappeared entirely except for a thin streak of calcification on the right side.

We have recently seen two cases of dorsal Pott's disease with fusiform abscess which were operated upon (spinal fusion) and which within a year developed secondary foci within the abscess area (Fig. 3). Such a complication is easily understood when one realizes that in this disease the actual tuberculous focus alone does not have to be considered, but in such cases a large sac of broken down material with tubercle bacilli free in the fluid surrounds other adjacent bodies that may appear to be normal. That one or two or perhaps more secondary tuberculous foci may develop would almost seem inevitable, unless the abscess recedes with unusual rapidity, and this is not the case as a rule.

We have occasionally seen such abscesses shrink within a period of a year (Fig. 2). However the damage to the bodies is usually done and there are left behind vertebrae more or less invaded by tuberculosis, and often a third or more of the bony substance itself may be gone due to the erosion. That such a bony column should hold up and not sooner or later give rise to a deformity of much greater degree seems too much to expect. We have not been able to observe our cases long enough to be sure, but we have records of several cases with this type of abscess ten to fifteen years ago, and recent observations on the same cases

FIG. 5. c. Case showing two lesions; above, fusiform and globular abscesses, below, small calcified psoas abscess.

show just such an increase in the deformity (Fig. 4). This is but one of many such cases to be seen, and it is our contention aspiration. The lack of favorable reports on these procedures makes it seem that no one has found a successful means



a b c

Fig. 6. Types of abscess in lumbar Pott's disease.
a. Large psoas abscess with some "flocculent" calcification.
b. Four abscesses from the same lesion.
c. One abscess.

that for the most part the severe deformities seen in dorsal Pott's disease are *not due to any peculiar mechanical disadvantages which that portion of the spine presents*. On the other hand, Ménard[4] contends that the ribs and thorax are a support which to a certain extent prevents the development of deformity in the thoracic spine. We believe though that these severe thoracic deformities are *due to the widespread dissection of the periosteum of the dorsal vertebrae which takes place as a result of the abscess*. This leaves an extensive area outside of the primary focus which is damaged to a variable degree, and which is thus weakened and apt to collapse later on.

The question of treatment of these abscesses is perhaps out of place in a discussion such as we are here presenting. We will mention only the forms which have been proposed. Ménard's costotransversectomy no doubt reaches the abscess, but according to all reports almost invariably leaves a sinus and secondary infection which is more serious than the original abscess. Various types of trocars and other devices have been proposed for of permanently evacuating these abscesses without establishing sinuses.

What secondary effects on other organs may take place due to these abscesses has not been studied. So far as I have been able to find in the literature no one has taken up this question. The occasional emergency arises when due to these abscesses high in the mediastinum a severe dyspnea develops, but for the most part, as far as we have been able to observe, most of these abscesses lie dormant. It seems that some of these must cause secondary changes of some sort, but we cannot demonstrate the changes. Their slow growth allowing for gradual stretching of the soft tissues probably accounts for the apparent lack of change in other organs due to direct pressure from the abscess.

Calcification of the contents of these abscesses may be frequently seen. This sometimes appears as flocculent or flaky areas in the abscess shadow. At other times the entire area appears as a dense shadow. The calcification is of some significance, but cannot be regarded as healing of the lesion. As a rule, calcification accompanies

diminution of the size of the abscess and is a more or less favorable sign.

THE LUMBAR ABSCESS

The lumbar abscess presents a problem of a very different nature. Here we have a different anatomical structure. The abscess early breaks away from its close contact with the spinal column. It finds this exit along the sheath of the psoas muscle as a rule.

This lack of dissection of the lumbar vertebrae is easily demonstrated, and the results are obvious. There are of course fewer vertebrae opened to damage by the abscess whether it be from mechanical dissection or from inflammatory extension. It is well known that we have fewer vertebrae involved by about one-half in the average lumbar Pott's disease as compared with thoracic Pott's. On the other hand, the abscess extends outward along the psoas sheath.

The abscess at this stage is often demonstrable in the roentgenogram. Any enlargement of the normal psoas shadow or along it when accompanying a spinal lesion is presumptive evidence of tuberculosis of the spine with psoas abscess. Their progress from this stage may be watched roentgenologically to a certain extent. One of three things may occur:

1. It may absorb and ultimately disappear, leaving little or no evidence of its former existence (Fig. 5).

2. It may calcify and either enlarge or decrease in size, usually the latter when calcification is marked. These calcified abscèsses reach a state where they no longer change in size and may be regarded as dormant or silent (Fig. 6).

3. With the escape of the abscess to the subcutaneous tissue and the ultimate drainage either by spontaneous rupture or by surgery, roentgen-ray evidence of the abscess usually disappears. We do not usually see any evidence in the roentgenogram of an abscess that has become emptied itself whether or not it becomes secondarily infected.

As long as the abscess remains within the retroperitoneal spaces it is not a serious problem. When it travels beyond the fascia, however, and becomes a subcutaneous mass it begins to be a menace. Many may, of course, be evacuated and will recede permanently. On the other hand, too many of them continue to push on until they have established a sinus which sooner or later becomes secondarily infected. Once such secondary infection is established the prognosis is always poor. Many of these cases die either from the infection itself or from the usual complication, amyloid disease.

Thus we have *the most serious menace to life in the abscess of lumbar Pott's disease.* Its effect on the deformity is of minor importance. On the other hand, *the thoracic abscess is a serious menace because of its influence on the deformity*, but of less danger to life itself.

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OSTEITIS FIBROSA AND ALLIED DISEASES OF BONE

(THE OSSEOUS DYSTROPHIES)

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THERE is an interesting and interrelated group of bone disorders characterized by softening, thickening and deformity of the bones, appearing at totally dissimilar age periods, and presenting variable clinical symptoms. The fundamental histological picture is essentially the same, but the clinical manifestation is so different in each type that many names have come into use, implying pathological entities where merely anatomical variations exist. The latter to some extent explains the confusion apparent in textbooks, which describe cases of osteitis fibrosa cystica in one section, bone cysts in another, osteitis deformans in a third and giant cell tumors ("benign sarcoma") in a fourth. While it is true that the exact relation of the last mentioned to the group of osseous dystrophies remains in doubt, it is now practically certain that the first three are merely types of the same disturbances, and bear some relation to rickets and osteomalacia.

The etiology of the entire group (rickets, osteomalacia, osteitis fibrosa and osteitis deformans) is unknown. Trauma, infection and endocrine disorders have all been postulated, and by various limited diets almost any type of dystrophy can be produced experimentally. But the changes are not constant, and it is difficult on such hypotheses to explain the occurrence of the condition (e.g., localized osteitis fibrosa) in an apparently healthy individual on a normal diet.

As regards trauma, areas of circumscribed osteitis fibrosa with or without hemorrhage and cyst formation have often apparently followed injury, especially in persons with a "tendency to an osteoporotic dystrophy," but the occurrence of histologically identical lesions in regions and patients where the possibility of even slight trauma could be excluded seems to invalidate this theory.

Parathyroid hyperplasias and tumors have frequently been found in association with the various malacias of bone, but their connection is not clear. Erdheim, among others, believed that the hyperplasia is not the cause of the bone changes, but merely associated with the increased calcium metabolism. Lambie recently reported cases of osteitis fibrosa with hyperparathyroidism, describing the dystrophy as a "chronic condition characterised by bone rarefaction, bone tumours containing giant cells and parathyroid hyperplasia (the glands being sometimes as large as a pigeon's egg and easily palpable in the neck)." He reports blood calciums as high as 17 mg., with normal acid-soluble phosphate and slightly lowered inorganic phosphate. Vitamin D was used therapeutically, but with what results he did not say. Dawson and Struther's theory is that the bone cell, by means of its processes in the bone canaliculi and with the aid of a parathyroid hormone, has a specific function, fixing the calcium in, and controlling the metabolic activities of, the area of bone assigned to it. If the nutrition of the bone cell is affected (e.g., by metabolic disturbances) or the regulating hormone deficient or defective in some manner, the "control of the bone cells over absorbed lime salts is disturbed" and the primary change of the osteodystrophy is initiated.

Lastly, the question of a nutritional origin is still being studied. The severe hunger-osteodystrophies (malacias) that occurred in Vienna towards the end of the war were very striking. Bone rarefaction and destruction was accompanied by fibrous tissue marrow changes and occasionally hemorrhages, giving a histological picture indistinguishable from osteitis fibrosa. Weber, working at present at the Hooper Foundation, believes he can produce dystrophies varying from an osteomalacic type to an osteitis fibrosa (histologically) by simply starving his

dogs for four weeks. He seems to think the primary lesion is a dysfunctioning "osteone" (an appellation based on the belief that the highest cell unit in the osseous system is as highly specialized as the highest cell type in the nervous system). But, once established, it is still uncertain whether the condition is curable by supplying a mixed diet, including vitamins A and D.

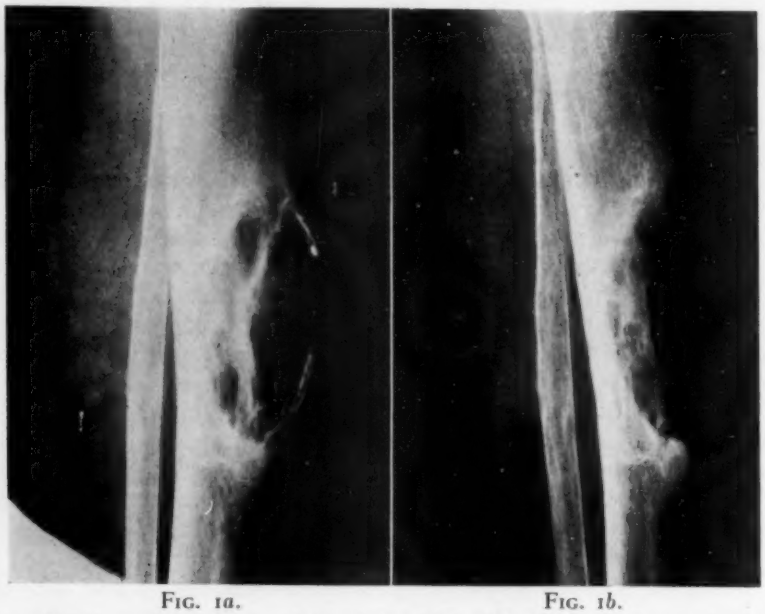

FIG. 1a. FIG. 1b.

FIG. 1a. Osteodystrophia fibrosa localisata involving shaft of left tibia. Chest, skull and other long bones negative.
FIG. 1b. Same case, three months after operation. Subsequent course benign.

Pathologically, the four conditions appear definitely related, the chief difference being a matter of degree. All share in common a disturbance in the normal relation between bone resorption and bone apposition, which leads to softening. When apposition does not follow resorption (or follows insufficiently) osteoporosis develops; when nature then attempts reparation, disordered apposition may occur with patchy or irregular osteosclerosis. Knaggs exemplifies the relation in this fashion; he believes these bone diseases are of "toxic origin" (developing especially in "predisposed individuals"):

> if their resistance is poor, no reaction occurs—osteomalacia, if their resistance is fair, some reaction occurs—osteitis fibrosa, if their resistance is good, marked reaction occurs—osteitis deformans.

Others suggest that the attempted repair (but with defective calcification) of osteomalacia in children gives rise to osteitis fibrosa cystica, and in adults produces osteitis fibrosa deformans. But borderline cases occur, and cases of either type irrespective of age, rendering the sequence

FIG. 2. Osteodystrophia fibrosa localisata involving lower end of right femur. Exploratory osteotomy. Microscopical report and subsequent course benign.

of events inconstant, and hence both these hypotheses dubious.

The rachitic dystrophy is characterized by exaggerated and irregular cartilage formation with deficient calcification; fibroblastic and osteoid tissue develops, especially in the metaphysis (instead of osteoblastic and osseous tissue).

The osteomalacic dystrophy (true osteomalacia, as distinguished from senile, hunger, and malignant forms) develops at an age when endochondral ossification is complete. Softening seems to occur from "simple dissolving out of the lime salts" or halisteresis, leaving zones of decalcified tissue, and from the production of osteoid tissue. These zones of osteoid tissue in turn are resorbed, reappearing possibly under repair or after fracture. Fairly often periods of partial recovery occur with the development of local changes like those seen in osteitis fibrosa. A humerus showing coincident osteomalacia and osteitis fibrosa, from a woman, aged thirty-four, who had puerperal osteomalacia with multiple fractures, is illustrated in Knaggs (Fig. 159, p. 325). As a rule, little or no fibrous tissue is seen; but the marrow changes are inconstant; osteoclasts are few or absent.

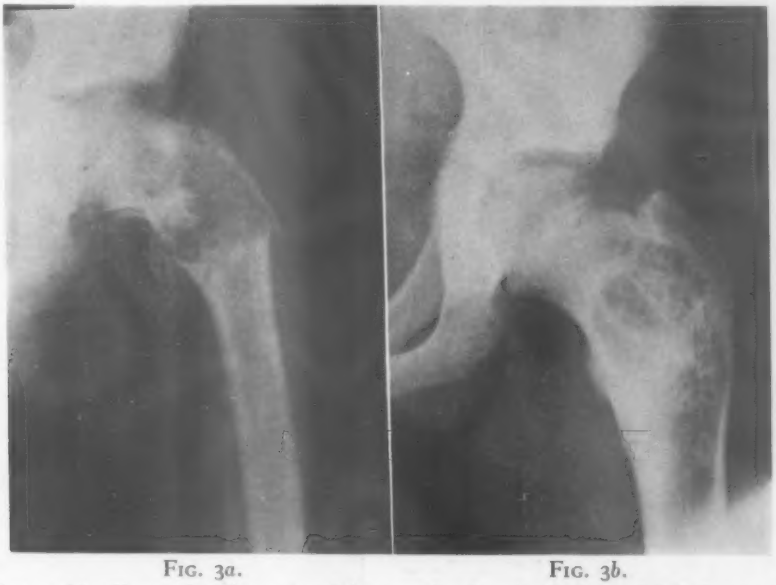

Fig. 3*a*. Fig. 3*b*.

Fig. 3*a*. Osteodystrophia fibrosa localisata involving proximal end of shaft of left femur; pathological fracture (August, 1925).

Fig. 3*b*. Same case, two years later. Fracture healed; cyst-like lesion slightly more extensive. No symptoms.

The fibrous osteodystrophy is characterized by *fibrous tissue change of the endosteal marrow*, by *extensive bone resorption* (both by halisteresis and lacunar erosion—many osteoclasts taking part)

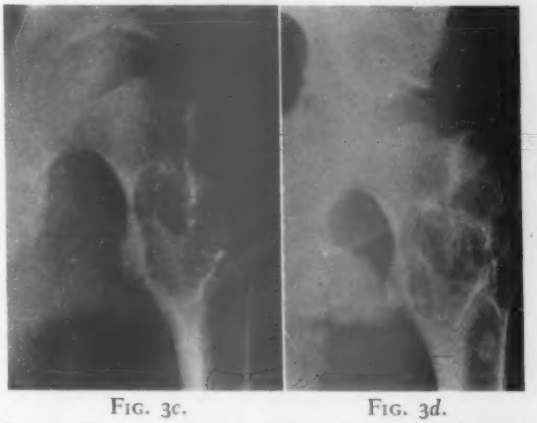

Fig. 3*c*. Fig. 3*d*.

Fig. 3*c*. Same case, one year later (1928). Trial course of high voltage roentgen therapy given (500 r in air, anteriorly and posteriorly).

Fig. 3*d*. Same case, six months later (1929); no change.

and by *a variable amount of bone formation throughout the fibrous tissue* (?not metaplasia). That is, energetic resorption and repair go on, apparently hand in hand, but with no round cell infiltration, no shell bone and usually no periosteal reac-

tion. Most writers suggest that the marrow change is the initial process (disappearance of marrow cells, and formation of vascular

FIG. 4. Osteodystrophia fibrosa localisata (or possible silent giant cell tumor) involving right ilium. No symptoms.

fibrous tissue) but Dawson and Struthers believe the primary change occurs in the bone cell, with irregular erosion (by halisteresis and endosteal osteolysis) preceding marrow fibrosis. Weber sums up the development of the changes as (1) resorption, (2) fibrous marrow, (3) fibroblastic osteoid tissue, but (4) with no shell bone. According to Kaufmann, secondary changes in the marrow may occur, either regressive, with focal liquefaction and *cyst* formation, or progressive, with formation of small, circumscribed brown or red *giant cell tumors*. These brown tumors may, by hemorrhage, in turn become cysts but "most of the solitary cysts in the long bones are probably the result of circumscribed osteitis fibrosa."* A further progressive alteration of the bone marrow may lead to the typical epulis (according to v. Recklinghausen), though others classify this with the blastomata. What relation these small giant cell areas scattered through the fibrovascular marrow tissue in osteitis fibrosa bear to the large giant cell tumors (that occur not infrequently at the epiphyseal ends of long bones) has not been determined. Although histologically and even macroscopically identical, the latter are all still classified with the benign neoplasms of bone.

FIG. 5. Osteodystrophia fibrosa localisata (?) healed, involving shaft of left femur, so-called enostosis. No symptoms.

The osteodystrophy of Paget shows a similar histological picture to that seen in osteodystrophia fibrosa. The main difference is that osteosclerosis is more evident, and giant cell areas and cysts usually absent (i.e., the end-stages of osteitis fibrosa are not seen).

Rickets, and its less common manifestation, late rickets, will not be dealt with in this short article.

Osteomalacia, owing to its extreme rarity in America, will be only mentioned. It may occur at all ages, but is so often associated with pregnancy that most cases are seen in women between the ages of twenty-five and thirty-five. Women who have never borne children, and occasionally men also suffer (the non-puerperal type including the most severe cases). The bones most frequently affected are

* The exact mode of origin of non-parasitic bone cysts is still disputed. Mikulicz, in 1904, was the first to give a precise description ("fibro-cystic juvenile dystrophy") and described a precystic stage of localized fibro-osteoid tissue with numerous giant cells. They are, of course, really false cysts, having only a fibrous tissue pseudo-membrane. Pommer and Looser believe they are of hemorrhagic origin. Probably they arise in two ways: (1) in osteitis fibrosa circumscripta, (2) in bone hemorrhages (marrow hematomas).

the pelvis and vertebrae (there being a central osteoporosis with soft pulpy marrow, varying from yellow to red in color,

FIG. 6. Osteodystrophia fibrosa localisata (?), involving shaft of left femur, complicated by fracture.

and liquid or "fibrous" in consistency). Deformity of the bones is usually preceded by vague pains and lassitude; the softened pelvic walls sinking in laterally produce the "heart-shaped pelvis" with "pubic beak;" the chest may show the "bell-shaped thorax." Fractures occur which heal with excessive but noncalcified callus. The course is variable, lasting months or years. Commonly it extends over three to six years during most of which time the patient is bedridden. No certain therapy is known.

FIG. 7*a*. FIG. 7*b*.

FIG. 7*a*. Osteodystrophia fibrosa localisata involving shaft of left humerus.
FIG. 7*b*. Same case after curettage.

Osteitis fibrosa and osteitis deformans, and their various forms, the main theme of this article, will now be considered. Christeller's classification (used by Weber) is by far the most complete and comprehensive, but its rather verbose terminology renders it unwieldy and, in spite of the inaccuracy of the suffix "-itis," the older terms will probably continue in use.

1. OSTEITIS FIBROSA, or osteodystrophia fibrosa, may be described as a disease in which localized patches of fibrous tissue, with or without cysts and brown tumors, occur in the bones, there being no obvious primary inflammation. It may occur at any age and shows two main types: a localized type, most often seen in young individuals, and a generalized type, usually occurring in elderly persons (when it is sometimes difficult to distinguish it from osteitis deformans and osteomalacia). It usually involves the shaft, especially of the tube bones, is usually painless, and frequently first manifests itself by fracture. Other signs include bony enlargement, deformity (due to bending), and limp (due to shortening). The affection may be mild and, even though generalized, compatible with active work throughout a fairly long life, or may be so incapacitating (e.g., by pain or repeated fractures) that amputation of the affected limb is welcomed. The long bones and skull are the most frequent sites of disease. Usually rapid healing follows fractures (with callus, both central and peripheral).

FIG. 7*c*. FIG. 7*d*.

FIG. 7*c*. Same case about one year later; arm painless but not able to be used properly.
FIG. 7*d*. Same case after second operation; arm 2 inches shorter than right, but with good function.

Spontaneous healing may occur, but the development of giant cell tumor and even sarcoma has been reported.

FIG. 8. Osteodystrophia fibrosa circumscripta, with fracture, shaft of left humerus. Subsequent course: benign.

Clinically and roentgenologically two main types occur, the generalized and the localized.

(1) Generalized osteitis fibrosa (*osteodystrophia fibrosa generalisata*) or von Recklinghausen's disease of bone. First described in 1891, it is always associated with multiple cysts and giant cell areas, from which the term osteitis fibrosa cystica arose. Up to 1920 Roth could collect only 40 cases from the literature, but probably many more have been seen though not reported.

(2) Localized osteitis fibrosa occurs in two forms: a diffuse form occupying a considerable portion of the diaphysis of a single bone, and a truly localized or circumscribed form limited to a small area of bone. As these two types produce very different roentgen appearances, the former is called *osteodystrophia fibrosa localisata*, and the latter *osteodystrophia fibrosa circumscripta*.

Examples of osteitis fibrosa localisata include some so-called multilocular bone cysts and some types of epulis and leontiasis ossea. v. Recklinghausen and Stumpf believe epulis to be "the highest stage of development" in a localized osteitis fibrosa of the jaw; but Kaufmann and others classify it as a "giant cell sarcoma." Knaggs divides leontiasis ossea into two types: (1) leontiasis ossea due to a creeping periostitis of the facial and skull bones (usually beginning in the nasal fossae or sinuses), and (2) leontiasis ossea due to osteitis fibrosa of the facial and skull bones. Kaufmann considers several types, under the term hyperostosis cranii (some arising on a basis of osteitis fibrosa, some on osteitis deformans, etc.). Schmidt (in Aschoff's "Pathology," 1923) classifies leontiasis ossea under osteitis deformans of the skull, but Bockenheimer places it with osteitis fibrosa.

Examples of osteitis fibrosa circumscripta include most non-parasitic solitary cysts, and central fibromas of bone. Konjetzny, however, believes that central fibromas are an end-result of giant cell tumor.

Diagnosis: The clinical course, the roentgenogram and the laws of probability will elucidate most cases. Biopsy in central tumors of bone is now recognized as being so misleading that even Ewing advises recourse to it only in exceptional cases. A pathological report of sarcoma is frequent (owing to the highly cellular nature of the lesions . . . the osteoblasts and endothelial cells giving a picture of round cell sarcoma, the fibroblasts of spindle cell sarcoma, while often the subsequent course shows benignancy. The roentgenograms show variable appearance, depending largely on the degree of resorption; usually uni- or multilocular, cyst-like areas are seen in the shaft of the bone, with little or no expansion, no evidence of periosteal reaction and usually no pain. Pathological fracture being common, the diagnosis (especially in single lesions) may become complicated. It is almost a *sine qua non* that flat films of the other

long bones and skull should be made, even where the diagnosis seems obvious.

The differential diagnosis is often very

Fig. 9a. Osteodystrophia fibrosa hyperostotica (Paget) involving pelvis and femora. This patient's tibiae were not affected, but practically all the other long bones, the spine and skull, showed advanced changes.

difficult and prognosis sometimes impossible from a single examination alone. The following lesions may produce confusing roentgenograms: giant cell tumor,

Fig. 9b. Same case, showing skull.

chondroma, myxoma, sarcoma and myeloma (rarely, chronic osteomyelitis, tuberculosis, syphilis* and parasitic bone cysts).

* Wilhelm gives this differential diagnosis between osteitis fibrosa (hyperostotic or deformans type) and the hyperostotic form of bone syphilis: in the former no periosteal new bone is seen, and uneven rarefaction of the medulla with lamellary cortical thickening occurs; in the latter there is usually very marked periosteal new bone formation with more or less sclerosis of the medulla and frequently dense cortical thickening.

To distinguish the solitary lesion from giant cell tumor and sarcoma is always the most serious problem; myeloma is

Fig. 9c. Same case, showing right humerus and radius involved.

rare and the differentiation from chondroma and myxoma rarely of great moment.

(*a*) Giant cell tumor usually involves the epiphysis, tends to expand the shaft rather than extend along it, seldom occurs under the age of fifteen, is frequently painful and almost always solitary. According to Kolodny the most common sites are the lower end of the femur and upper end of the tibia (47 per cent), the jaws (9 per cent), and the spine (8 per cent). Frequently the response to roentgen irradiation will clear up the diagnosis in doubtful cases.

(*b*) Chondroma and myxoma are rare, usually involving the bones of the hands and feet. Multiple chondroma may be impossible to distinguish (Jansen reporting a case of unilateral chondromatosis which,

had films of the opposite limbs not been made and the course not followed, would have presented considerable difficulty).

FIG. 10. Osteodystrophia fibrosa hyperostotica (Paget) involving pelvis and femora. Calcification (? metastatic) in uterine fibroid. No symptoms.

(*c*) Sarcoma (i.e., central sarcoma) in its early stages (cf. Hansen's Case 6) may be impossible to differentiate; cortical erosion and destruction is a late sign and not necessarily indicative of malignancy; invasion of the surrounding tissues is also a late appearance. Bloodgood thinks that central sarcomas, especially in young people, are very rare.

(*d*) Myeloma is usually multiple and commonest in middle life and in males. A typical case could hardly cause any confusion, but Hansen and others mention it as a serious consideration.

(*e*) Chronic osteomyelitis, tuberculosis and syphilis occasionally present cyst or central tumor-like lesions on the film; clinical examination usually identifies them. Parasitic bone cysts are very rare. Osteolytic carcinoma metastases seldom resemble the malacias under consideration.

Prognosis. This varies with the type and position of the lesion. While essentially benign, and liable to spontaneous cure following fracture, chronic unresponsive cases of osteodystrophia fibrosa occur. The apparently undoubted fact that sarcoma has developed in a few instances makes one ever cautious.

Treatment. This also depends on the type and position of the lesion. In the generalized type, nothing beneficial is known as yet. In the solitary and localized types, simple curettage (with fragmentation of the bone shell) has had excellent results in the hands of Bloodgood and others;

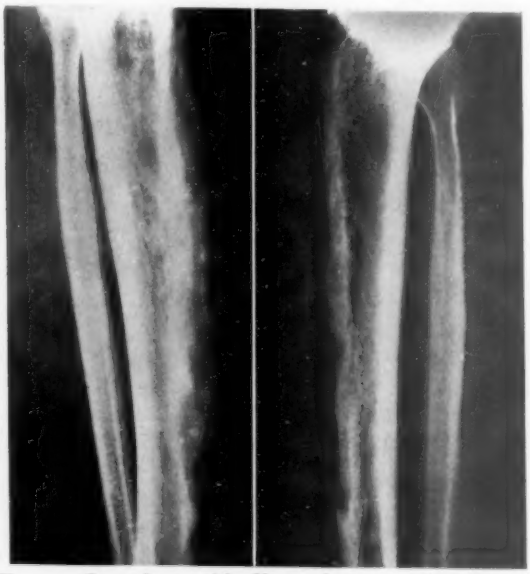

FIG. 11. Osteodystrophia fibrosa hyperostotica (Paget) involving both tibiae (left and right shown). No other bones involved except skull, which shows barely discernible thickening with faint areas of osteoporosis and sclerosis. No symptoms.

some advise cauterizing the cavity (Hansen "boils it out"); Sisk has produced rapid healing by scattering bone chips or placing a tibial transplant in the cavity (depending on its size). In the localized types which are impossible to distinguish from giant cell tumor (either clinically or on the film), Herendeen, Ewing, and Evans and Leucutia advise irradiation rather than exploratory incision, for several reasons. Giant cell tumors constantly respond to irradiation, preferably a full course of deep therapy; the pain may persist for some time after the course is finished, but, following a variable degree of further decalcification, bone formation sets in, and the limb or other region involved returns to normal function. If the lesion fails to respond and shows sign of extension, roentgen-ray examination of the chest should be made (for central sarcoma pulmonary metastases are often evident in a film long before they manifest themselves clinically) and exploration arranged for (with permission to amputate if malig-

nancy is found, and metastasis reasonably remote). The reasons for not exploring in the first instance are that: (*a*) central tumors are most often benign; (*b*) there may be no response to deep therapy once a giant cell tumor is incised (Herendeen thinks it makes them radioresistant), and (*c*) there is always the possibility of hemorrhage, infection and spread of malignancy (if such be found and the surgeon does not have permission to amputate). Radiation does not appear to damage areas of osteitis fibrosa and the usual surgical treatment for such is not altered. Whether or not it has any curative action, especially in bone cysts, has not yet been decided; it would be very valuable to try a series of cases with careful, thorough deep therapy.*

Fig. 12*a*. Left and right tibiae of Case XII. Left normal. Right showing changes of both the simple and the hyperostotic forms of osteodystrophia fibrosa, with fracture in shaft. Films taken three months later showed bony union.

Fig. 12*b*. Right and left femora of same case. Right normal. Left showing changes indicative of hyperostotic osteodystrophia fibrosa. Films of skull showed no thickening or abnormality.

II. Osteitis Deformans (osteodystrophia hyperostotica porotica) is a disease in which localized patches of fibrous tissue occur in the bones, usually without cysts or brown tumors, arising without obvious primary inflammation. Bone resorption is usually not so marked as in osteitis fibrosa and bone formation more evident (both osteoid and poorly calcified bone being common). It may occur at any age and shows two main types: the *generalized* type, commonest during middle and late life, the *localized* showing no age preference (cases of both have been reported under the age of thirty). Painful and painless varieties are seen, and fractures from slight cause may occur (though less often than in osteitis fibrosa). The bones most frequently involved are the long bones and skull, the tibia being the site of election for the monosteal or localized type. Softening, thickening and bending of the bones produce the obvious deformities, and sclerosis frequently devel-

* The great number of needless amputations for giant cell tumors is tragically testified to by the beautifully illustrated Pathological Supplement to the *Brit. J. Surg.* for 1926 (vol. xiii) which shows numerous specimens labelled "myeloid sarcoma" removed from young and middle-aged individuals whose subsequent course showed them to have had anything but a sarcoma.

ops in the late stages preventing further deformity. Atheromatous arteries commonly occur in patients with the disease, and

FIG. 12c. Left elbow of same case. Humerus shows changes typical of osteodystrophia fibrosa hyperostotica (with old fracture of medial condyle). Right humerus is normal.

calcareous deposits ("metastatic calcifications") are seen in various tissues, especially, according to Dawson and Struthers, in the lungs, gastric mucosa and kidneys. Renal calculi appear to be not uncommon.

Clinically the two types seen are the generalized and the localized. (1) Generalized osteitis deformans was first described by Paget in 1876. It is the type most commonly seen and, for the most perfect description of it, Paget's own article[13] or the abstract therefrom in Knaggs' book cannot be improved on. (2) Localized or monosteal osteitis deformans is not a very rare condition (though up to 1928 less than 50 cases could be collected from the literature). It seems nearly always to involve the tibia.

Diagnosis. The age (usually over thirty), the thickening and bowing of the affected bones, and the early involvement of the femora and tibiae will usually differentiate cases of generalized Paget's disease. Enlargement of the skull occurs. Cases are seen where the tibiae are not involved, but the ulnae are affected. Roentgenograms show a variable appearance, depending on how much sclerosis follows the porosis; usually areas of osteosclerosis and osteoporosis are contiguous, the porosis producing small, cyst-like rarefactions in the thickened skull and pelvis. Immense thickening with linear streaking due to osteosclerosis is not uncommon. In the roentgenograms, borderline cases that are indistinguishable from osteitis fibrosa (and also from bone syphilis)* have been reported.

The differential diagnosis in typical cases is obvious. But without films of skull and femora, it may be impossible, for example, to distinguish a case of hyperostotic Paget's disease of the pelvis or lumbar spine from a case of osteoplastic metastatic carcinoma. The extensive, linear, cortical thickening, usually with linear osteosclerosis and, in the tube bones, bowing, will ordinarily differentiate the condition. Probably many cases, especially of the monosteal type, are indistinguishable from osteitis fibrosa.

Prognosis. Like osteitis fibrosa, osteitis deformans is a benign, usually progressive, lesion. Some cases develop deafness, and Knaggs mentions syringomyelia and Huntington's chorea as occasional complications. Borderline cases merging into osteitis fibrosa occur, and these are probably especially liable to fracture. Apparently authentic cases developing giant cell tumor are on record; but the most serious complication is sarcoma. It is difficult to say what percentage of patients develop malignancy, but the number is not by any means small (Segale mentioning 11 cases in recent literature).

Treatment. Nothing beneficial is known.

CONCLUSION

In conclusion it may again be stated that osteitis fibrosa and osteitis deformans are histologically and anatomically identical. As Kaufmann says, "they are simply types of the same disturbance." Clinically and roentgenologically they manifest themselves in many diverse, and often curious ways, though both most often affect

*See footnote, page 523.

the long bones and the skull. With the increasing use of the roentgen ray in examination it seems probable that more and more borderline cases will be found, cases which can merely be said to belong to the osteitis fibrosa type of dystrophy, but are neither clear cases of osteitis fibrosa cystica nor osteitis deformans. Both types show spontaneous remissions, but on the whole the former, in its localized types, is as subject to cure (either surgical or by roentgen ray) as the latter is resistant to any form of therapy. Whether certain diets (high in calcium and vitamins A and D) will prove remedial is still uncertain.

The following (Table 1) is suggested as a practical classification (as far as our present knowledge goes) of the types of osteodystrophia fibrosa.

Fig. 13*a*. Left femur of Case XIII, showing multilocular cyst-like lesion of shaft, presumably osteodystrophia fibrosa localisata. Films of pelvis and thorax negative.

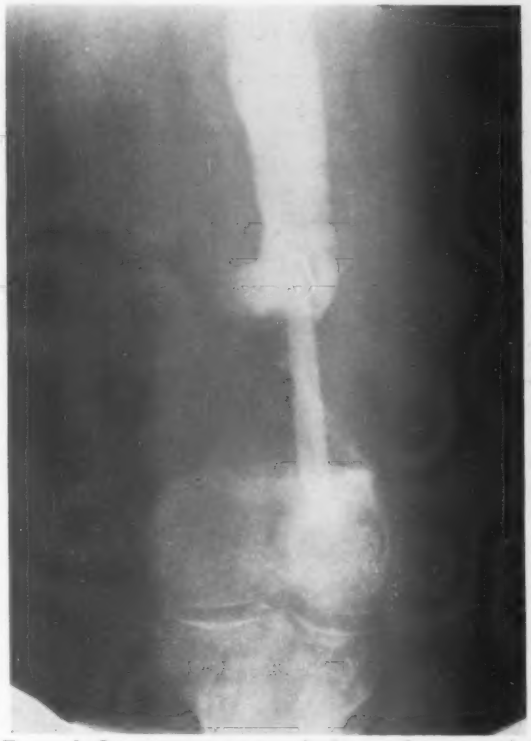

Fig. 13*b*. Same case, ten months later, after operation and insertion of graft. The callus is not well brought out in the print. Subsequent course of this case (after amputation of this leg) benign. See Case XIII for details.

Table 1

Osteodystrophia Fibrosa	type in which *Porosis* predominates	*Generalisata:* (v. Recklinghausen).	"Osteitis Fibrosa Cystica"
		Localisata: incl. *many* forms of	Multilocular Bone Cysts
			Epulis
			"Leontiasis Ossea"
		Circumscripta: incl. *most* forms of	Solitary "Bone Cysts"
			Central "Fibromas"
	Hyperostosis predominates	*Generalisata:* (Paget)	"Osteitis Deformans"
		Localisata.	"Monosteal Osteitis Deformans"

CASE REPORTS

Case 1. H. P., male, aged sixty-two. Admitted with lump on left shin. This developed about thirty-two years previously, following a blow with a sledge-hammer. This lump rose immediately but has grown very slowly since them. It has never been painful, but patient felt that his leg was "weak" for the last year. Orthopedic diagnosis: enchondroma, left tibia.

Roentgen report (on films of legs, chest and skull, September, 1928). Osteitis fibrosa cystica or giant cell tumor, left tibia. Chest and skull negative.

Operation (September, 1928). Soft bone mass dissected out of tibia, fibro-fatty material curetted out and cavity allowed to fill with blood clot.

Pathological report. Much fibrous tissue

with cellular areas containing round and spindle cells; small calcified zones in places: fibrosarcoma.

Subsequent course. Benign. Films taken in December showed no bone destruction (beyond operative defect) and some early calcification.

This is a classical case of osteodystrophia fibrosa localisata. From subsequent experience we doubt if giant cell tumor should even have been considered as a possibility; also, judging from Sisk's article, had bone chips been scattered in the blood clot healing would probably have progressed more rapidly.

CASE II. Mr. K., adult. History of recent injury to right leg. Sent for examination to exclude fracture.

Roentgen report (May, 1928). Osteitis fibrosa cystica, localized type, lower end right femur; left femur negative. Operation was however undertaken, the surgeon considering that malignancy should be ruled out by biopsy; exploratory osteotomy.

Pathological report. Benign lesion of the osteitis fibrosa type.

Subsequent course. Benign. Films taken six months later negative, no change.

This is another typical case of osteodystrophia fibrosa localisata. We doubt if biopsy would be indicated, should other cases of this type come to examination.

CASE III. T. M., male, aged ten. Admitted with injury to left hip in August, 1925.

Roentgen examination (August, 1925). Fracture through multilocular cyst-like area in proximal end of shaft of left femur. Subsequent films of right hip and both lower legs negative. Treatment. Plaster cast.

Subsequent course. Benign. Films in March, 1927, show fracture healed, but cyst-like lesion slightly more extensive; clinically painless and benign. Films in September, 1928, show no change. One course of high voltage roentgen therapy (500 r (measured in air) front and back with 200 kv., 0.5 mm. Cu) given in October. Films taken in April, 1929, show no change. Patient is at school and quite active.

This is presumably a case of osteodystrophia fibrosa localisata. While it did not resemble a giant cell tumor, either clinically or roentgenologically, the irradiation was tried to see if any effect would be obtained. Patient is now on a high vitamin and calcium diet.

CASE IV. Mr. K., adult. No symptoms; accidental finding of multilocular, cyst-like area in right ilium when experimental film of pelvis was made while trying out a new tube. Subsequent course (over one year): Benign.

This is presumably a case of osteodystrophia fibrosa localisata.

CASE V. Mr. S., aged twenty-eight. Admitted with injury to left femur, possible fracture. Roentgen examination showed only a small area of sclerosis, irregular in type, projecting into medulla of shaft. Subsequently quite painless. Blood Wassermann negative. Clinical diagnosis: possible enostosis.

This is possibly a case of healed osteodystrophia fibrosa localisata (?).

CASE VI. Mr. P., aged nineteen. Admitted with pain above right knee and slight discharge from sinus 10 cm. proximal and lateral to patella. This patient fractured his right femur in 1922; open reduction was done followed by two further openings for infection. In 1923 a sequestrectomy was performed. In January, 1927, reopened spontaneously, discharged pus and closed. In June, 1928, again painful with some discharge (first seen by writer). Gradually closed but had to be reopened in June, 1929; sequestrectomy.

Roentgen examinations in 1927, 1928 and 1929 all showed practically the same appearance: an old united fracture of the shaft with a peculiar, boomerang-shaped, cyst-like area below the line of union. Original films from 1922 not obtainable. Other bones negative. Blood Wassermann negative.

This is possibly a case of osteodystrophia fibrosa localisata, complicated by fracture or subsequent to such.

CASE VII. R. W., male, aged eight. Admitted with note that "Patient has a cyst of the left humerus, which has been curetted and the tissue examined, but the lesion not cured." Not painful, but hinders use of arm.

Operation (July, 1922). Upper 7 cm. of shaft of humerus removed with cystic growth. Subsequent course apparently benign; arm 2 inches shorter than right.

This is presumably a case of osteodystrophia fibrosa localisata, though a

peculiar area of chronic osteomyelitis cannot be entirely ruled out till many months after the recent operation.

Case VIII. C. S., male, aged thirteen. Admitted with injury to left arm.

Roentgen examination (January, 1923) showed a so-called bone cyst, with fracture. Subsequent examinations in February and March showed rapid healing, with peripheral and apparently central callus.

This is presumably a case of osteodystrophia fibrosa circumscripta.

Case IX. Mrs. H., aged about forty-five. Admitted with dull pain in right buttock; slight deafness; general asthenia. Clinically classical Paget's disease, with the only exception (the reason for describing the case here) that the forearms and *not* the lower legs were bowed. Blood Wassermann negative; blood calcium 10.3 mg. Films showed extensive involvement of femora, pelvis, spine, skull, humeri and radii; also dense areas scattered through lumbar muscles (interpreted as bizarre metastatic calcifications) and advanced arteriosclerosis.

Typical case of osteodystrophia fibrosa hyperostotica.

Case X. Mrs. McD., aged about fifty. Vagus abdominal pains. Roentgen examination to exclude biliary or renal calculus. None found.

Typical case of osteodystrophia fibrosa hyperostotica with beautiful metastatic calcification in a uterine fibroid.

Case XI. R. G., male, aged forty-five. No symptoms. Had fractured his patella seven years ago and now had film of knee taken for curiosity. Films (1928) showed marked Paget's disease in right tibia with slight changes in left tibia and in skull. More careful scrutiny of films taken in 1922 showed that a diagnosis of monosteal or localized osteodystrophia fibrosa hyperostotica might easily have been returned then.

Case XII. Mrs. M. J., aged fifty-one. Admitted with injury to left elbow, and one week later, with injury to right leg. On December 21, 1928, an automobile struck patient. She fell and examination showed possible fracture of lower end of left humerus. Her arm was put up in a splint. On December 28 while waiting for a street-car she felt a cracking sensation in her right leg, fell and could not walk again owing to the pain.

Roentgen examination showed fracture through medial condyle of left humerus, there being osseous changes strongly suggestive of Paget's disease, and fracture through right tibia, there being an appearance typical of osteitis fibrosa cystica. Subsequent films of rest of skeleton showed a remarkable distribution of lesions; rather marked changes of Paget's disease were evident in pelvis and left femur, but right femur, left tibia, right humerus and skull showed no involvement at all.

Roentgen examination two months later showed good callus about both fractures. (Patient stated that twenty-seven years ago, that is, when she was about twenty-four, she noticed forward and lateral bowing with slight enlargement of right leg. It never caused pain, but the bowing and swelling gradually increased.)

This is an excellent case of co-existent changes typical of simple osteodystrophia fibrosa and osteodystrophia fibrosa hyperostotica.

Case XIII. Mr. B., aged sixty-six. History of swelling about left thigh. Roentgen examination in January, 1926, showed multilocular, cyst-like lesion, shaft of left femur; interpretation doubtful, possibly sarcoma. Films of chest and pelvis negative. Clinical diagnosis. Apparently benign lesion.

Operation (January, 1926). Excision of diseased area, insertion of bone graft. Pathological report: Osteitis fibrosa cystica and giant cell tumor.

Roentgen examination in February, 1926, showed the operative defect in the shaft, and the bone graft, which had slipped out inferiorly; no appearance suggestive of neoplasm. Roentgen examination in March showed no change. The graft was replaced in position. Roentgen examination in April and May showed a very small amount of callus. Roentgen examination in October, 1926, showed slight demineralization about cortex of distal end of proximal fragment; poor callus; films of pelvis and chest negative for metastasis.

Clinical diagnosis. Malignancy. Third operation (October, 1926). Amputation of leg at hip joint. Pathological report. Sarcoma. Roentgen examination in December, 1926, negative for any evidence of metastasis.

Subsequent course. Benign.

This case is of extraordinary interest. It appears to constitute one of the four surgically cured cases of osteogenic sarcoma reported in the literature. In view of the ten month interval between the first operation and the subsequent amputation, in view of the fact that after two operations absolutely no metastasis occurred and in view of the first roentgen appearance and pathological report, the probability of this being a case of osteodystrophia fibrosa localisata must be strongly considered. In none of the films is there an appearance that could be called absolutely indicative of malignancy; the subsequent course does not suggest such and the postoperative course almost rules it out. It is, however, possible that (in view of the second pathological report) this is a case of sarcoma developing in a hitherto benign osteodystrophia fibrosa type of lesion. If so, whether it developed after or before the surgical procedures is a matter for interesting speculation.*

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* The writer wishes to express his indebtedness to Dr. Rehfisch, and to Drs. Chamberlain, and Newell for permission to publish the roentgenograms of many of their cases.

† Denotes articles most consulted in preparation of this paper.

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CALCIFICATION OF INTRATHORACIC EXUDATES

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IN spite of the amount of research that has been carried out on calcium metabolism during the last decade, and of the knowledge that we have gained as to its importance in human economy, when we take stock of our actual knowledge we realize how little we actually do know of this important subject.

MacCallum[6] states *inter alia* that "calcium circulates in the blood and other body fluids in combinations which are not clearly known. There are many theories but little clear knowledge. Normally calcium is deposited in solid form only in bony tissues, but deposits are found in many abnormal situations. The chief of these are in caseating tuberculous foci; but also deposits, often only minute spicules or granules, are found in tissues where normal metabolism has been abolished. Concerning the mechanism of these abnormal deposits much thought has been expended without arriving at a satisfactory explanation.

"Exudates such as are found in an old empyema or purulent pleurisy and old fibropurulent exudates in the pericardium often become markedly loaded with lime salts. It would appear that any dying tissue embedded in a living tissue and accessible to the circulating fluids will gradually tend to become calcified."

Naturally the diagnosis of these conditions during life is a roentgenological one. In this connection the three cases to be reported are of some interest, not so much from a clinical point of view perhaps, as from the infrequency with which such cases are reported.

As mentioned above, the etiological factors have been discussed at some length by different authors. Some[1] incline to the theory that tuberculosis is largely responsible; but there are others,[3,5] who are equally certain that the cause is non-tuberculous. In the cases which are being reported the findings are in favor of the claims of the latter group.

The cases are of some interest in that they present one feature in common, namely, all the roentgenological signs are unilateral and are located on the left side, though I have not been able to ascribe any significance to this fact.

CASE REPORTS

CASE I. A male, aged sixty, gave a history of a severe purulent pleurisy some thirty years previously. Since that time there had been no recurrence of any trouble, though at times he complained of a feeling as if something were present in that side of the chest.

Roentgenographic examination of the chest, during the course of a routine examination, showed an elongated shadow extending downward from the left root and laterally towards the costophrenic sulcus (Fig. 1). The shadow was wider and more irregularly calcified at the hilus of the lung, narrower and more densely infiltrated at its tip. Undoubtedly it lies in the interlobar septum and represents the remains of an interlobar pleurisy. Apart from this, the roentgenogram shows a few scattered shadows but nothing to indicate particularly any previous tuberculous infection.

CASE II. A female, aged sixty-two. This case is of considerable interest. Here the discovery was made accidentally during the course of an abdominal investigation.

Her history was that she had had for the last three years an inconstant, shifting, dull, aching pain in the upper abdomen. The pain occurred more particularly on the right side and was not related to food; there was no nausea nor vomiting nor was there any flatulence. The urine was discolored at times and was gritty. On consulting her medical adviser, Dr. McAra, a tumor was discovered in the right upper abdomen which was definitely tender on palpation, and it was for further investigation of these findings that she was referred to our department. When seen the patient looked somewhat cachectic. On discovery of the pulmonary condition further inquiry was made into her previous history and it was found that on two occasions in her early life she had had pneumonia on the right side. "Many years ago" she had what was described as congestion of the left lung.

For the past few months she has felt a catch under the left breast on going uphill or upstairs.

The screen findings show that there is a competent surgeon, but no lesion could be detected in the abdomen. This has left us with a single condition in the left hemithorax to

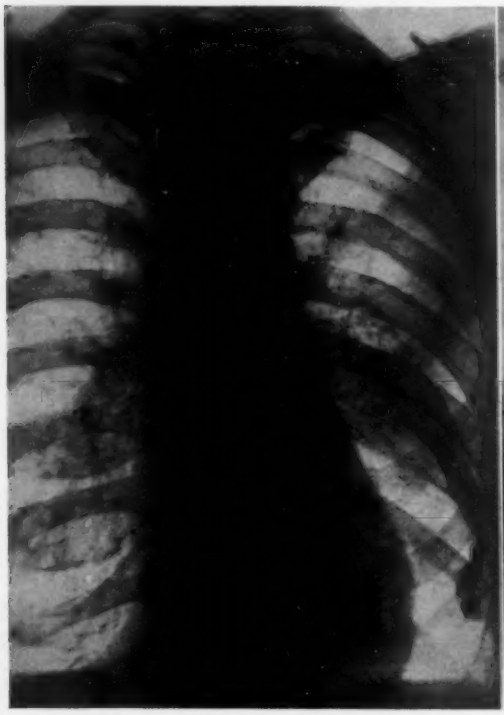

FIG. 1. Case I. Calcification of remnants of interlobar pleural exudate. Left lung. Thirty years after infection.

FIG. 2. Case II. Calcification of left-sided pleuropericardial exudate; dense pleural exudate on left side.

deposit of calcium salts apparently on the lateral aspect of the pericardium and extending down from the level of the coronary sulcus to the apex of the heart. Here the shadow becomes more diffuse and spreads out in an irregular fashion ultimately becoming continuous with a dense shadow which extends across from the cardiac shadow to the lateral chest wall (Fig. 2). It was interesting to note that the normal cardiac pulsation could be observed throughout the whole extent of this shadow, which made it evident that the deposit did not consist of one solid mass. Seen in profile the shadow appeared ring-shaped, and it was interesting to observe in this view that the other shadow noted above evidently lay in the same plane as the heart as it could not be differentiated in this view from the cardiac shadow (Fig. 3). The size of the cardiac shadow was not increased.

As a result of the examination of the abdomen, it was considered that indications pointed to the advisability of a laparotomy, malignancy of the gall-bladder or pancreas being suspected. This was duly carried out by a

discuss. It is only reasonable to suppose that an infection of the pleura overlying the pericardium would give rise to symptoms which might be described as "congestion of the lung." The exudate has dried up and become calcified in the course of time, but there has been in addition some thickening of the other layers of the pleura as shown by the density at the left base. It is interesting to note that for all these years this armor plating around the left ventricle has caused the patient no discomfort and it is only now towards the end of middle age that the heart is beginning to protest at being so confined, when it is called upon to do some extra work.

CASE III. This case is of very great interest and will be discussed at some length in view of its rarity and also in view of the possibilities which it opens up in the diagnosis of pericardial conditions. It appears that this woman was referred to our department on account of her symptoms some nine years ago with a tentative diagnosis of mediastinal tumor, probably the result of hydatid infection. It was then recognized that an abnormal condition was present and on account of the

calcifications noted it was suggested that she had a dead hydatid lying behind the heart. This patient, a well-developed young woman, aged thirty-two, was referred the second time on account of breathlessness and swelling of the abdomen and lower extremities, said to have been brought on by undue exercise. She had been resting for a few days during which the swelling became greatly reduced. When seen the pulse rate was not raised but the lower extremities were obviously swollen and the abdomen distended with fluid. The only history it was possible to extract from her was that though she had never been actually ill, she had never been able to indulge in violent exercise since girlhood on account of the epigastric pain which it induced. Nevertheless since her attack in 1920 she has been able to play golf and tennis.

On roentgenoscopy in the posteroanterior position the first thing noted was the enlarged globular shape of the cardiac shadow with denser shadowings on the left side (Fig. 4). Then it was observed that pulsation was absent on the right and left sides of the cardiac shadow except at the actual apex of the heart itself where alone any excursion was noted. The suggestion made at this stage that it was a case of calculous pericarditis was confirmed by examination in the lateral direction which showed that the calcification actually lay to the front of the cardiac shadow (Fig. 5). In the effort to portray more accurately the actual calcifications the Potter-Bucky diaphragm was used and this gives more exactly the actual distribution of the calcium salts. The appearance suggests that deposition has been more complete in the neighborhood of the cardiac blood vessels (Fig. 6).

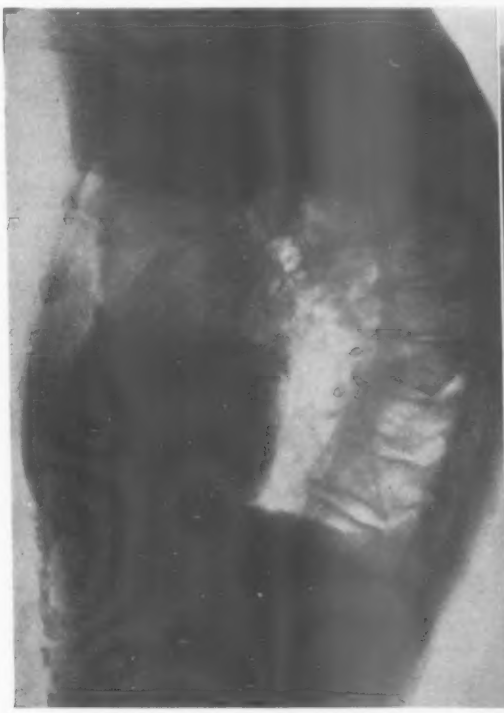

Fig. 3. Case II. Left lateral view, showing superimposed shadows of the heart, calcifications and pleural exudate.

Fig. 4. Case III. A case of pericarditis calculosa.

So far as one can ascertain this makes the nineteenth case of calculous pericarditis which has been diagnosed during life. It is interesting to consider some points that have been raised in connection with this condition by other authors. Case[2] states that in 1899 Diemer[4] suggested that roentgen rays could be used to diagnose in the living subject a condition which previously had been detected only at autopsy. The honor of reporting the first case, however, actually fell to Schwarz of Vienna in 1910.

Scholz,[7] in his review of the literature of calcifications in and around the heart, points out that when degeneration of a tissue takes place, that tissue exhibits a

decreased tolerance for calcium salts and deposition takes place. The first tissue or portions of tissue to be affected are the elastic tissue fibers. It is interesting to note, moreover, that in his series of collected cases of calcification of the heart a large number gave an antecedent history of a septic infection.

FIG. 5. Case III. Left lateral view, showing anterior situation of calcifications.

FIG. 6. Case III. Special plate taken with secondary diaphragm to show the distribution of the calcifications.

Cutler and Sosman[3] make an interesting and ingenious suggestion. They point out that in a series of 1000 autopsies Wells noted 4 cases of pericardial calcification in 128 cases of adhesions. As they say, pericardial adhesions noted post mortem are for the most part of little importance so that in a large percentage of cases of adherent pericardium calcification can be expected to occur. In view of this fact, and the further one that clinical diagnosis of adherent pericardium is so uncertain, it would appear that roentgenology has found another direction in which it can assist the clinician in arriving at a diagnosis.

In view of the foregoing it is reasonable to suppose that the demonstration of calcium deposits in the pericardium provides satisfactory evidence of the presence of adhesive pericarditis, but at the same time we must remember that both intra- and extracardiac calcium deposits can be, and actually have been, demonstrated roentgenologically in the living subject,[7] and that it will be necessary in future to distinguish between intra- and extracardiac deposits of calcium salts.

ROENTGENOLOGICAL TECHNIQUE

Certain roentgenological details have to be considered in connection with this condition. First of all, in order to pick out these areas of calcification we require rays of sufficient hardness to penetrate the thickness of the cardiac muscle in reasonable numbers. Secondly, the exposure must be reduced as far as possible in order that movement may be reduced to a minimum, though in this connection it is worth pointing out that owing to the adhesions present there is actually very little movement of the cardiac shadow. Finally, I would suggest that the use of a

secondary diaphragm may still further increase the number of cases detected. I personally have obtained the most interesting pictures by this means.

SUMMARY

(1) From a consideration of the material available it appears that pathological deposits of lime salts within the thorax are preceded by retrogressive changes in the tissues affected and that in the non-tuberculous forms there is nearly always an antecedent history of sepsis.

(2) The premise advanced by Cutler and Sosman that calcification must occur in a large percentage of cases of adherent pericardium appears to be well supported by the evidence that they adduce, in which case the roentgenologist should be able to provide the clinician with considerable aid in the diagnosis of adherent pericardium.

(3) Three cases of extensive non-tuberculous intrathoracic calcification are reported, one being the nineteenth recorded case of pericarditis calculosa diagnosed during life.

(4) Suggestions for roentgenological technique are: increased penetration, short exposure and where possible the use of a secondary diaphragm.

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NONTRAUMATIC DIAPHRAGMATIC HERNIA*

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IN 1610 Ambroise Parè[9] reported two cases of traumatic diaphragmatic hernia. This is the first report in the literature of any type of hernia through the diaphragm. Thoma[13] reported up to 1900, 238 cases, 8 of which were esophageal. Richards[10] reported (1900 to 1923) 137 cases, 22 of which were esophageal. Healy[4] (1922) reported 30 cases and later (1925) added 23, making a total of 53, all of which he believes to be herniations through the esophageal hiatus of the diaphragm. In 1925, Friedenwald and Feldman[3] reported 6 cases and in 1926 Pancoast and Boles[8] added 15, all of which were on the left side. The 7 cases which we are reporting are added to the literature with the idea in mind of interesting the clinician and roentgenologist particularly, in those cases diagnosed clinically as gall-bladder disease or ulcer, in which the roentgenologist not infrequently renders a negative report.

The type of lesion dealt with in this paper is that in which there is a herniation of a portion of the stomach wall, usually on the greater curvature side, through the hiatus. A very unusual case of herniation of a portion of the transverse colon through the diaphragmatic hiatus has been observed by Dr. E. A. Merritt, and with his consent we are reporting it along with our series of cases.

The contributions of Richards[10] and Healy[4] have apparently stimulated interest in this condition, especially the type in which the cardia of the stomach protrudes through the esophageal opening, and as a result a condition which up to quite recently had been considered to be extremely rare, has by virtue of more careful examination and by careful tech-

*Read before the Medical Society of the District of Columbia, October 24, 1928.

nique, been found to be a not uncommon pathological and clinical entity.

Richards[10] gives an extensive and thor-

FIG. 1. Case 1.

ough description of the anatomy and the embryology of the diaphragm. He describes the various types of herniation and the localities where herniation is most likely to occur, as follows:

(1) Anterior: Situated to one side of the diaphragmatic attachment of the sternum, and occur almost entirely through Larry's space or the foramen of Morgagni, where there is a triangular muscular defect between the sternal and costal attachments of the muscle.

(2) Central: Situated in central portion of diaphragm.

(3) Posterior: Situated in the lumbar region, between the vertebral and costal portions of the diaphragm at a point where the pleuroperitoneal canal has failed to close.

(4) Esophageal: Through the esophageal hiatus.

(5) Others: Such as by way of the openings for the sympathetic nerve chains in the crura of the diaphragm and by way of the azygos vein openings. Another rarer point of herniation is through the floor of the pericardium.

Herniations through the openings for the aorta and vena cava have never been reported. It is true that the aorta is occasionally found in the hernial openings as in one of our cases (Case III), but this was evidently due to the fact that there was an extreme defect on one side of the diaphragm and not because there was a herniation into the aortic opening. The reason for the rarity of herniations through these openings is undoubtedly due, in the case of the aorta, to the fact that anatomically and developmentally it is situated posterior to the diaphragm and is enclosed in a tendinous non-muscular ring and is closely attached to the vertebrae by the crura on either side; in the case of the vena cava, to the fact that the walls are closely attached to the central tendon, and because of the extensive liver tissue about it.

INCIDENCE

The Mayo Clinic, in the paper of Carman and Fineman,[2] records finding 20 cases up to July, 1924, an incidence of one in 18,000 cases examined. These were all recorded as being of the nontraumatic esophageal variety. Pancoast and Boles,[8] in reviewing the literature, found an incidence of one case in 3500, according to the separate reports of Béclère, McMillan and Rendick. In their own series of 15 cases, 14 per cent of which were nontraumatic, they found an incidence of one case in 600 examinations of the gastrointestinal tract. Morrison[7] found an incidence of one in 83 cases of various types of diaphragmatic hernia. In our series of approximately 400 cases, we have made a diagnosis of nontraumatic diaphragmatic hernia in 6 cases, 3 of which were proved at operation, 2 of which were not operated upon, and one in which the pathologist was unable to find herniation at autopsy.

ETIOLOGY

The age has varied in the cases reported from five to seventy-five. The condition appears to be more common in women than in men. Congenital abnormal development of the omental bursa as suggested by Bund[1] may account for many of the

cases, particularly those found in children. Richards[10] states that the most important factor in the causation of these hernias

Fig. 2. Case II. (Retouched.)

is an interference with the normal closure of the pleuro-peritoneal membranes in fetal life. Healy's indirect trauma theory that the direct causative factor is an increased intra-abdominal pressure seems quite plausible. The hiatus is made up of what is practically a slit in the muscular portion of the diaphragm, which happens to be the most easily distensible portion of the structure. Bearing this fact in mind, one can readily understand the mechanics of the production of these hernias. When we consider that the history of these patients not infrequently shows a more or less protracted period of transient increases in intra-abdominal pressure, such as would result from the violent coughing in pertussis or chronic bronchitis, the straining at stool, or the straining in the second stage of labor, we can understand why herniation in this area should occur. In one of our cases (Case I) the symptoms became more active following an attack of whooping cough six months previous to admittance to the hospital.

SYMPTOMATOLOGY

Although the patient may be symptomless, it is unusual. The usual symptoms are often identical with those of gall-bladder disease or with gastric or duodenal ulcer. Substernal pain just below the ensiform cartilage, regurgitation and abdominal distress upon assuming a recumbent position, are the most common

Fig. 3. Case III.

complaints. One patient who came under our observation gave as her only symptom the inability to enjoy her usual nap after a hearty meal because of the substernal distress. She was compelled to assume an upright position for an hour or two after meals. The pain may be severe and colicky at times and may radiate to the back and between the shoulder blades. There may be pain with flatulence and belching two to four hours after meals, relieved by alkalies. There may be a definite relation to meals. Even at times a seasonal variation may occur, thus simulating the picture of ulcer. Difficulty in swallowing is occasionally complained of. Nausea and vomiting when they occur often give relief. The acid eructations which is such a common symptom can probably be explained on the basis of relaxation of the cardiac sphincter. In Morrison's series this occurred in all of his cases, but in Friedenwald and Feldman's cases it occurred only once. Relaxation of the sphincter occurred in all of our cases. In some instances the symptoms are respiratory and suggest a cardio-vascular condition.

DIAGNOSIS

The diagnosis is seldom made clinically. It can be readily made by the roentgenologist if careful examination of the lower esophagus is made. The patient should first be placed in the upright position and the course of the meal as it passes down the esophagus should be noted. As the barium enters the stomach a clue is often given by a slight retardation of the meal, or a sharp turn of the barium to the left. When the stomach has been filled the patient is examined in the right and left oblique and Trendelenburg positions and in the prone and supine positions by making pressure on the abdomen while the patient takes rapid and deep inspirations. In our experience the pouch fills more rapidly in the horizontal position. As soon as the pouch fills the barium usually passes up into the esophagus. A gas bubble is sometimes observed, but this is unusual. If the pouch fails to fill, straining or coughing may cause it to fill. Repeated examinations may be necessary to bring out the defect.

In this condition the stomach is usually found to be of the cow horn, or transverse type; the fish-hook type is rarely observed. The size of the pouch varies usually from that of a hazel-nut to that of a large orange.

Fig. 4. Case IV.

Fig. 5. Case V.

In a differential diagnosis the following must be considered:

(1) Cardio-esophageal relaxation without herniation, described by Robins and Jankelson[11] in which there is a relaxation of the cardiac sphincter and dilatation of the lower esophagus, but no evidence of a pouch. The most constant symptoms, according to these authors, is fullness and distress in the epigastrium and a lumpy sensation in the lower portion of the sternum. Pain was not noted in any of these cases.

(2) Diverticulum at the lower end of the esophagus. In this condition there is a budding off from the esophageal wall and the filling takes place directly from the esophagus instead of passing first into the stomach.

(3) Diverticulum of the stomach wall discloses itself as a pouch directly connected with the stomach, but lying below the diaphragm.

(4) Cardiospasm shows a marked delay in the meal with a v-shaped constriction of the esophagus.

(5) Hour-glass stomach. The apparent pouch is here again below the diaphragm. In this connection, however, it is of interest to note that ulcer in the herniated area of the stomach is not uncommon. Kienböck in 1914 reported 32 such cases. Occasionally they rupture and give rise to pyothorax.

Fig. 6. Case vi.

(6) Carcinoma appears as a filling defect rather than as a pouch. The outline is irregular and the meal trickles down to one side of the midline if observed in various positions.

(7) Perforation of the esophageal wall with the formation of a pseudo pouch has been observed to simulate hernia. Inasmuch as nontraumatic perforation is usually the result of a malignant ulceration the usual signs of carcinoma are present in these cases.

(8) Congenitally short esophagus described by LeWald[6] in which the stomach of necessity lies in the thoracic cavity may be ruled out by careful study of the esophagus in various views while patient swallows the meal. Esophagoscopy often gives more accurate results than roentgenoscopy in these cases.

TREATMENT

The treatment is purely surgical. In 1912 Scudder[12] found in the literature 53 cases which had been operated upon. Eleven of these cases were approached through the thorax. Seven recovered and 4 died. Of the 42 cases approached through the abdomen, 7 recovered and 35 died. The high mortality rate in this series was evidently due to the fact that many of these cases were associated with intestinal obstruction.

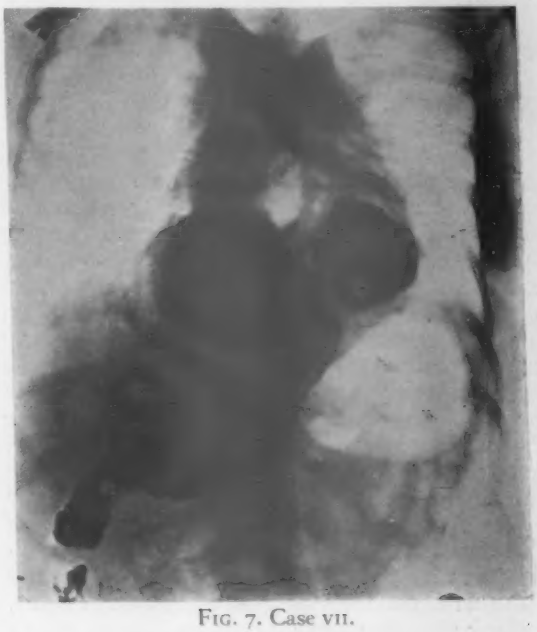

Fig. 7. Case vii.

Hedblom,[5] in reporting a series of 378 patients who came to operation for various types of herniations through the diaphragm, has found that operation for this condition is not as serious as had been supposed, and that the contraindications are very much overrated. This author found a 53.19 per cent mortality in cases with obstruction and 23.8 per cent in cases without obstruction.

The thoracic route, in ordinary cases, was found by Hedblom, as well as by others, to be the better site for entrance. In many cases the abdominal approach is necessary, and in others it is advisable to use both routes.

In a communication from Dr. T. R. Healy, in regard to the technique of operation for nontraumatic diaphragmatic hernias, we quote the following as used by several Boston surgeons:

"The mode of surgical procedure in general is a high, left-sided epigastric incision. Sometimes it is necessary to undercut the lower costal cartilages and bring them forward in order to get sufficient room to expose an adequate field. By high retraction of the upper end of the wound and downward traction of the stomach, the aperture in the diaphragm is exposed and the degree of closure necessary to prevent the prolapse of the stomach upward into the chest is estimated. The margin of the cleft anteriorly for this distance is then denuded or scarified. The edges of the hernial opening having been determined upon with the finger, a silk suture is placed at the anterior portion of the opening. This suture is then pulled upon and the next lower suture put in. In this way all the sutures can be placed so as to close the opening fairly snugly about the esophageal opening. Care must be taken to get the opening fairly snug about the esophagus and yet not get it tight enough to shut it off. Silk sutures are used for the purpose of approximating the edges of the hernial opening with the idea of making the adherence of the edges as permanent as possible. Some of the surgeons approximate with mattress sutures of chromic catgut. I think the great fault, however, is not to close the opening enough, thereby having a recurrence. I should like to put particular emphasis upon this point. Sometimes in a few cases, in a long narrow chest and high diaphragm, it is almost impossible to reach from below and these cases must be approached from above."

In one of our cases (Case III) Dr. C. S. White performed the following operation:

"Upper midline incision. Examination revealed a hernial opening through the diaphragm, between the attachments of the diaphragm to each side of vertebral column, forming a triangular opening through which the stomach would partially pass. The attachments of the diaphragm were so far separated that a plastic on the diaphragm could not be performed and the gastrohepatic ligament was attached to the diaphragm covering. The opening through the middle arcuate ligament was closed which prevented the stomach from entering the opening through which the aorta normally passes. The abdomen was closed without drainage."

"This patient made an uneventful recovery and to date symptoms due to the hernia have not recurred."

REPORT OF CASES

CASE I. F. N., aged seventy-six, housewife, referred to hospital by Dr. Conklin, with a tenative diagnosis of gall-bladder disease, or gastric ulcer. Previous history irrelevant except for vague gastric distress over a period of years, with an acute exacerbation of symptoms following an attack of whooping cough six months prior to admission. Her symptoms had not abated to any extent during this six months period. Roentgen examination revealed a large gallstone and a hernia the size of an English walnut (Fig. 1). The patient was not operated upon.

CASE II. E. A., aged seventy-four, female, married, white, referred by Dr. F. W. Braden. Past and family history irrelevant. Present illness began three months previous to admission, with a sinking feeling in the abdomen, substernal pain, very offensive gaseous eructations, nausea, no vomiting. The symptoms became progressively worse and the patient consulted her physician who made a tentative diagnosis of gall-bladder disease.

Roentgen examination of the gastrointestinal tract revealed calculi in the gall-bladder, new-growth of the lesser curvature of the stomach, and a walnut-sized herniation of the stomach wall through the esophageal hiatus (Fig. 2).

The patient was operated upon by Dr. W. A. Jack. The postoperative diagnoses were cholelithiasis, carcinoma of the lesser curvature of the stomach, herniation of the stomach through the esophageal hiatus, the hiatus being dilated sufficiently to admit three finger tips. No attempt was made to repair the hernia because of carcinoma.

CASE III. Mrs. S., white, aged fifty-four, referred by Dr. W. I. Robey, admitted with a tenative diagnosis of gall-bladder disease. The past and family history is irrelevant. Present illness began six weeks previous to admission. The onset was sudden and immediately followed patient's attempt to lift a heavy weight. The pain, which required opiates for relief, had no relation to the intake of food, was definitely localized between the scapulae and was aggravated while in the recumbent position. There was some nausea, but no vomiting nor blood in the stools. No previous operations.

Intravenous cholecystography showed a normally functioning gall-bladder. Gastrointestinal study showed a herniation of the stomach through the esophageal hiatus (Fig. 3).

CASE IV. K. E., female, white, aged fifty-seven.

The past and family history was irrelevant.

Present Illness. Gastric disturbance over long period of years. Some nausea. Occasional vomiting. Operated upon in 1919; cholecys-

totomy. Operated upon 1924; cholecystectomy. There was no relief and the symptoms persisted. Gastrointestinal study March 24, 1927, showed pouching of the stomach near the esophageal hiatus, which was very suggestive of herniation of the stomach through the esophageal hiatus, with some relaxation of the cardio-esophageal orifice (Fig. 4).

Operation refused.

Case v. H. G., female, aged sixty-three, white, married.

Family History. Irrelevant.

Past History. Six pregnancies.

Present Illness. Several years' duration. Attacks of substernal pain after meals, particularly when in supine position necessitating an unright posture for several hours after a full meal. Some nausea, occasional vomiting which would relieve symptoms.

Clinical Diagnosis. Cholecystitis.

Roentgen Diagnosis. Herniation of stomach through esophageal hiatus (Fig. 5).

Operative Diagnosis. Distention of esophageal hiatus admitting three fingers.

Case vi. M. H., female, aged fifty, white, married.

Present Illness. Respiratory distress and pain in left back of some months' duration. The pain was aggravated particularly by a full meal and while in a supine position.

Gastrointestinal study showed herniation of the stomach through esophageal hiatus (Fig. 6). Not operated upon.

Study of chest showed metastatic carcinoma.

Case vii. (Dr. Merritt's case.) Mrs. M. E. C., white, aged sixty-nine.

Family History. Irrelevant.

Past History. Usual childhood diseases—gall-bladder operation in 1925.

Present Illness. For the past two years following an operation for gall-bladder disease, patient noticed feeling of fullness in the epigastrium. This feeling was present almost continually but was aggravated by the intake of even small amounts of food. Nothing seemed to relieve it.

Physical examination showed rather marked tenderness in the epigastrium.

Gastrointestinal Study. Roentgenoscopic examination of the chest showed the heart somewhat to the left but no other definite evidence of abnormality. The stomach showed a defect in the pyloric portion which was explained in subsequent findings. There was some delay in evacuation of the stomach contents. At the end of twenty-four hours the barium meal was fairly well distributed throughout the large bowel and a rather large loop of the large bowel in the region of the transverse colon was in the thoracic cavity, having herniated there through the central opening of the diaphragm (Fig. 7). The patient could not retain an enema, but this was not believed to be the result of any organic pathology in the lower bowel.

SUMMARY

Nontraumatic diaphragmatic hernia has been shown in recent years to be a not uncommon condition.

Clinically the picture presents a right upper quadrant syndrome, simulating cholecystitis or gastric or duodenal ulcer. The most constant symptoms are pain in the epigastrium, regurgitation and abdominal distress upon assuming a recumbent position.

The diagnosis can be made with certainty only by means of the roentgen ray, by carefully studying the lower esophagus with the patient in various positions.

Differentiation should be made from: cardioesophageal relaxation of Robins and Jankelson, diverticulum of the lower end of the esophagus, diverticulum of the stomach wall, cardiospasm, hour-glass stomach, carcinoma, perforation of the esophageal wall, and the congenitally short esophagus described by LeWald.

Treatment is purely surgical.

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SIMULTANEOUS VISUALIZATION OF GASTRIC MOTILITY AND ASCERTAINING ITS CHEMISM

BY MEYER GOLOB, M.D.

NEW YORK CITY

THERE is no need to dwell upon the diagnostic value of a clinical estimation of gastric motility for the usefulness of this form of gastric examination, like that of the secretory activity of the stomach, has been affirmed by many writers and is accepted practice among gastro-enterologists. What invites medical attention in this respect now, is the development of a technique more acceptable to the patient and more dependable in practice than those available at present.

This paper is concerned with the possibilities looking to this end, and a suggestion embodying a new form of procedure is offered in the hope that collective experience and perhaps an orderly study along that line of action at a gastro-enterological clinic, will bring about an improved technique for estimation of the gastric motor function.

The method in use at present may be briefly summarized as follows:

1. Aspiration of the fasting contents following a motor meal.

2. Estimation based upon the amount recovered after ingestion of an Ewald test breakfast by the single test meal method.

3. Substitution of the fractional test meal method of Rehfuss for the single test meal method.

4. Roentgen investigation six hours after ingestion of a motor meal.

Incidentally it may be noted that the intramuscular or intravenous administration of neutral red, while of value in ascertaining the gastric secretory function, furnishes no information as to the gastric motor power.

It will be noted that the first three methods have in common a dependence upon aspiration and therein have a common weakness, for even normal patients do not take kindly to repeated aspiration.

For example, in the Ewald single test meal method, following aspiration of a few cubic centimeters of gastric juice for analysis, the remaining stomach contents must be ascertained by the introduction of a definite quantity of water and its subsequent recovery, together with all other stomach residue. But frequently the patient will object to a repeated aspiration and the operator will forgo it, necessarily content with having at least a few cubic centimeters of gastric juice for study of the secretory activity.

Occasionally, particularly when the patient is of the hypersensitive type, his apprehension of the procedure is so pronounced as to render futile any further effort on the operator's part to complete the study. He must be content with a few cubic centimeters for titration. Again, if the patient does not take the tube well, but gags and coughs in his efforts, the contraction of the abdominal muscles and the diaphragm may so result in squeezing bile out of the biliary tract, which mingles with the duodenal secretion and is regurgitated into the stomach. The addition of this fluid to the gastric contents renders the estimation inaccurate.

When the personal equation of the patient is happily such as to lend itself readily to the procedure, the fractional test meal method is excellent. In this respect I still advocate the conclusion in a paper published by me in 1923 on this subject, in which I said: "The procedure of Rehfuss is a clinical method of proved value whereby both motor and secretory activation may be studied during all the phases of digestion." But the method is obviously time-consuming, and in a busy clinic this is so weighty an objection as to lead to the use of the single test meal method in its place.

The fourth method, that of a roentgen investigation six hours after ingestion of a motor meal, requiring no resort to aspiration, has none of the objections attendant thereto. But it does not help in the determination of the rate of emptying, merely limiting its findings to the motor state of the stomach six hours after the meal, and, of course, it is of no use whatever for testing secretory activity.

This method has, however, served the writer as the foundation for the new technique he suggests.

This is, in short, the roentgenological visualization, at fixed intervals, of the motor function as it works on the elimination of a single test meal designed both to afford visualization and permit analysis for study of stomach chemistry.

The meal is prepared as follows: Four Uneeda biscuits are triturated in a mortar to a fine powder, mixed with 2 ounces of barium sulphate in an electric mixer containing 360 c.c. of water. The solution is swallowed by the patient. A plate (either in prone or vertical position) is taken immediately after ingestion of the motor meal. After the conventional time interval of forty-five to sixty minutes, a second plate is taken, the patient being placed in the same position and at the same focal distance as before. Following this second roentgenogram, stomach contents may be recovered for titration for acid values.

The rate of gastric emptying should be ascertainable from the measurement of the shrinkage in the shadow visualized roentgenographically.

The author believes that a series of observations recording the relation between a definite gastric content and its shadow on the roentgenogram would ultimately lead to the formation of a measuring scale for interpreting such shadows in terms of cubic centimeters of stomach content. The scale need not be true beyond a reasonable approximation.

Such a method would be least trying on the patient, economical of time, and in all probability much more accurate than the rough estimations of present methods. Moreover, as the procedure invokes roentgen investigation of the gastric lumen, it may bring to light points of value from the roentgenological viewpoint. Cases for the study only of the main gastric functions will through this method receive the advantages of a simultaneous study of its motility, secretion and morphology, the latter offering a chance to detect a lesion which might otherwise be missed.

It should be noted that the barium does not affect the gastric titer.

THE CALIBRATION OF BUCKY GRENZ-RAY TUBES FOR THERAPY

BY LILLIAN E. JACOBSON

NEW YORK CITY

THE calibration of Bucky grenz-ray tubes was the result of a practical demand. In using grenz rays it is essential

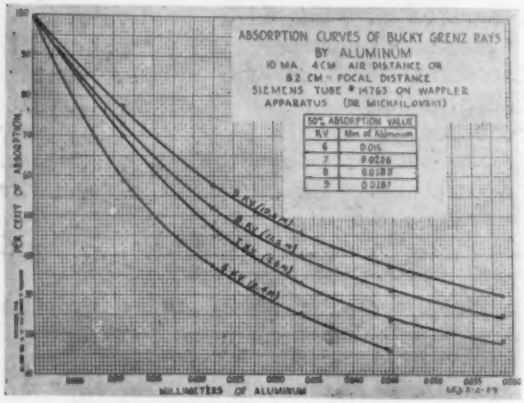

FIG. 1.*

to know the dosage which produces the best effects. It is necessary to use the same quality ray and the same quantity which have already been tried by a few leaders in the field of grenz-ray therapy, one of

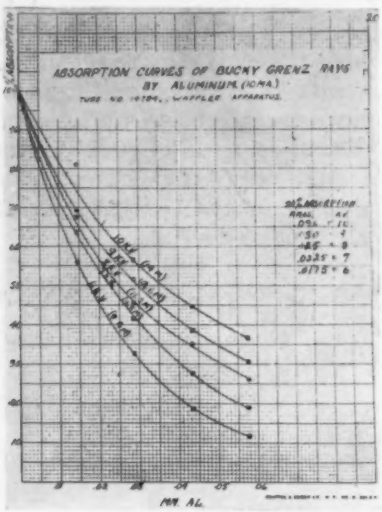

FIG. 2.

the foremost being Bucky. It is therefore advisable to have a definite means of comparison and a standard of dosage.

Each tube should be calibrated on the apparatus on which it will be used. The results obtained on one apparatus are

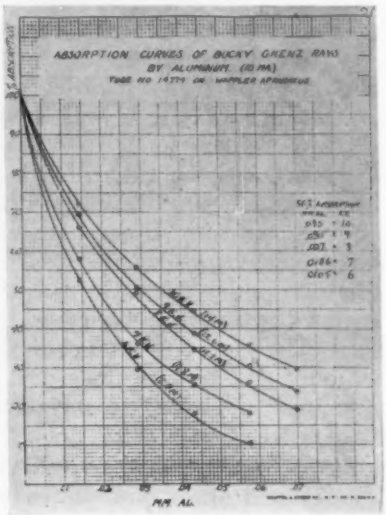

FIG. 3.

rarely applicable to another. Three things must be accounted for in calibration: (1)

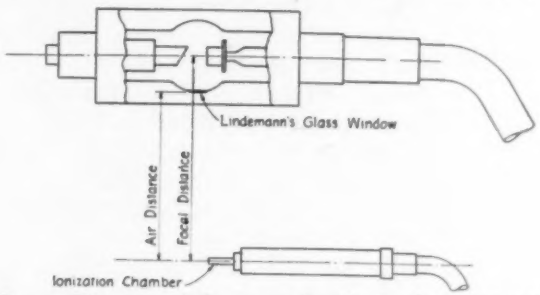

FIG. 4. Diagram of the set-up for the Bucky grenz-ray tube and ionization chamber.

The quality of the ray by the half-absorption value; (2) the variation of intensity with the different voltages and different distances from the tubes, and (3) the size and uniformity of the field.

(1) Quality Measurements. The quality of Bucky grenz rays can be described by the thickness of aluminum† which will

* Note that "per cent absorption" in ordinate of graph should read "per cent intensity." This change should also be noted in Figures 2, 3, 9, 10, 11, 12A, 13A and 14A.

† I wish to express my thanks to the Aluminum Corporation of America for their kindness in furnishing us with very thin sheets of pure aluminum.

reduce the intensity of the original ray beam to half its value. The thicker the aluminum, the harder or more penetrating is the ray. Figure 1 shows a set of absorption curves. The half or 50 per cent absorption value, that is, the number of millimeters of aluminum that reduce the original intensity to half its value, are given on the curve. In comparing the quality of grenz rays in two different tubes a comparison of the 50 per cent or half-absorption values should be made.

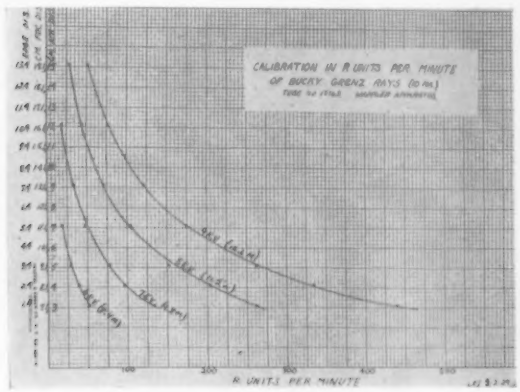

Fig. 5.

Compare the half-absorption values in Figure 2 with those in Figure 3; 0.036 mm. aluminum is the half-absorption value for 10 kv. (14 kv. max.) in Figure 2 and 0.035 mm. for 10 kv. (14 kv. max.) in Figure 3. These rays then have the same quality. The half-absorption value for 9 kv. (12.6 kv. max.) in both is 0.030 mm. aluminum. However, the half-absorption value of the 6 kv. (8.4 kv. max.) in Figure 2 is different from that of the 6 kv. (8.4 kv. max.) in Figure 3. In other words, the quality is different. Therefore, if one obtained results by using 6 kv. of Figure 2 or a half-absorption value of 0.0175 mm. aluminum, it does not follow that another will get the same results with the 6 kv. of Figure 3.

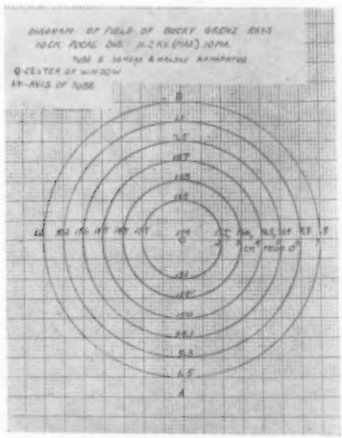

Fig. 6.

Fig. 7a. Photograph of Bucky grenz-ray field at 5 cm. air distance.

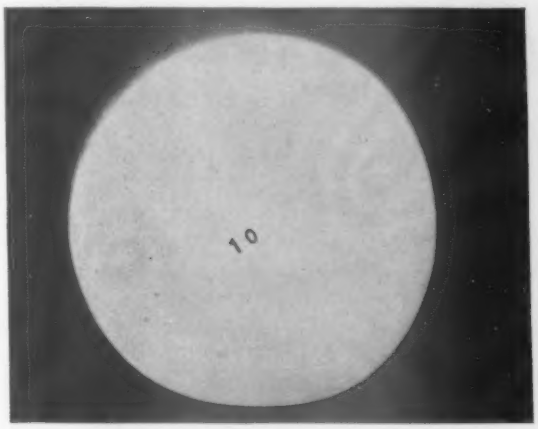

Fig. 7b. Photograph of Bucky grenz-ray field at 10 cm. air distance.

The kilovoltages that are recorded on the curves are those read from the meter on the apparatus. In parentheses is given the maximum voltage corresponding to the meter reading. Voltage and meter readings, however, should not be the criterion of grenz-ray quality. As will be shown later, tubes using the same kilovoltage may have quite a different quality ray beam. Thus, it

is seen that it is very important to define the quality of the beam, as by the half-absorption value in aluminum.

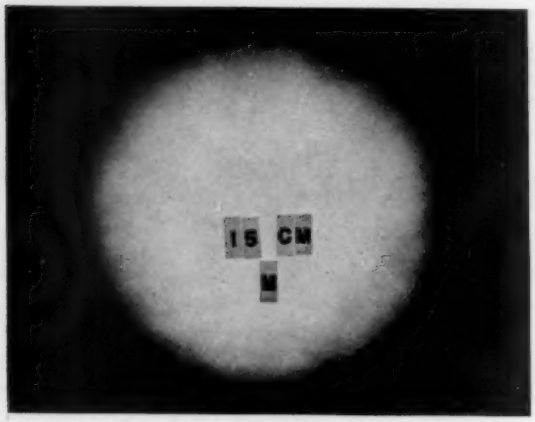

FIG. 8. Photograph of Bucky grenz-ray field of a tube with a ring target at 15 cm. air distance.

(2) Quantity Measurements. There should be a standard and precise method whereby the amount of grenz rays can be specified. This is now done by means of the r-unit, which may be defined as that ray

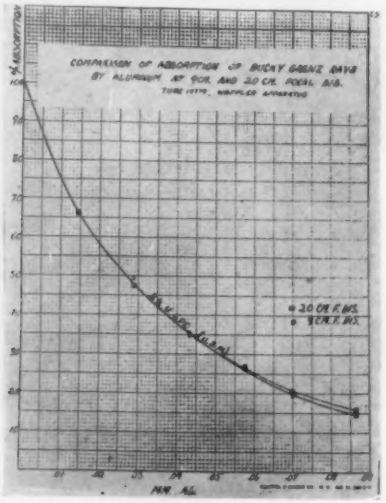

FIG. 9.

beam which produces a saturated ionization current of one electrostatic unit per cubic centimeter of air under standard conditions of temperature and pressure. The r-unit is then a standard unit of quantity measurement as a gram is a standard unit of weight in the metric system.

The measurements have been made by means of the Fricke-Glasser dosimeter. The set-up can be seen in Figure 4. A special soft-ray chamber, 1 c.c. in volume,

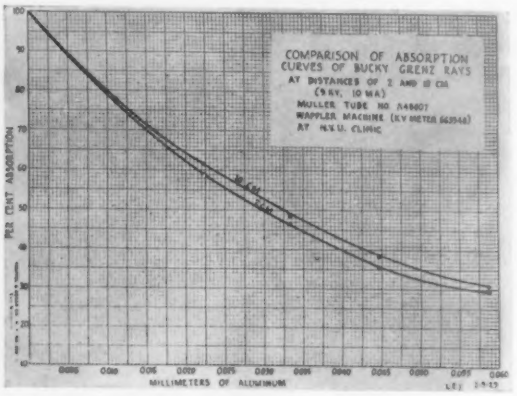

FIG. 10.

made of goldbeater's skin, is used.[2] The chamber is placed as close to the tube as possible; the air distance, that is, the distance from the Lindemann glass window to the chamber is measured. The distance from the target is also measured and this

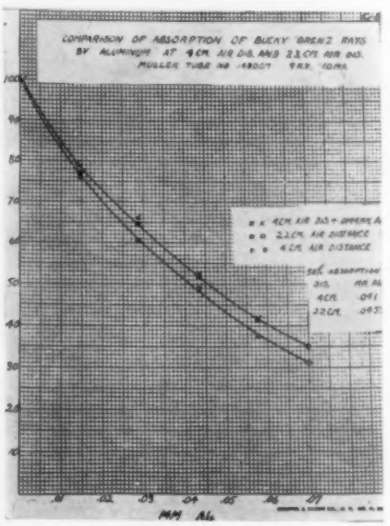

FIG. 11.

is called the focal distance. The kilovoltage is then varied and for each kilovoltage the number of r-units is noted. The chamber is then lowered 1 cm. and the number of r-units for each kilovoltage is again recorded. This is repeated until the distance is as large as will ever be used in

therapy. The results are plotted and curves are drawn for each kilovoltage. Figure 5 shows such a set of curves.

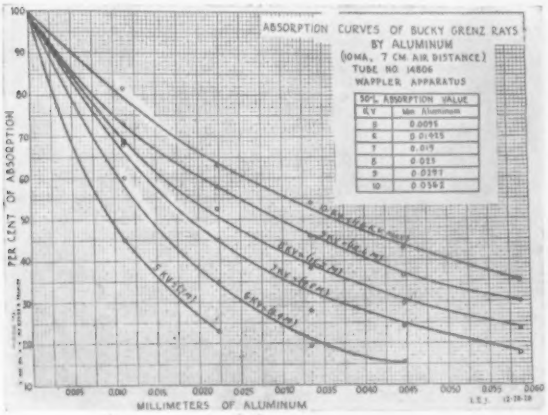

Fig. 12A.

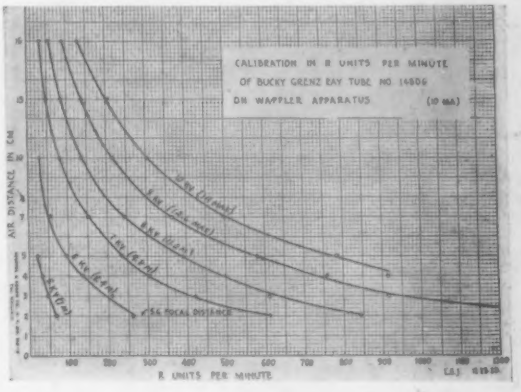
CALIBRATION IN R UNITS PER MINUTE
OF BUCKY GRENZ RAY TUBE NO. 14806
ON WAPPLER APPARATUS
AIR DISTANCE IN CM.
R UNITS PER MINUTE

Fig. 12B.

Let us say one is using 9 kv. (12.6 kv. max.) and the distance from the Lindemann glass window to the object is 5 cm. By looking at the 9 kv. curve in Figure 5 where the 5 cm. air distance line intersects it, we read 270 r-units per minute. This is then the intensity or amount of grenz rays which is being used in one minute.

Sometimes it is more convenient to know how long it will take to give a definite number of r-units. Suppose it is desired to give 100 r-units of the above rays at a distance of 5 cm. The time in seconds will be $100 \div {}^{270}/_{60} = 22$ seconds. A table can be prepared for each kilovoltage for each tube and the times can be read directly from this. Table 1 shows such a table for the curves in Figure 5.

(3) The Field. There are two ways of measuring the size and uniformity of the field. The first is by the use of the electrometer, the second is by the use of a photographic plate. Figure 6 is a diagram of the field made by moving the grenz-ray chamber to the left and right of the central

Table 1

TIME CHART FOR 9 KV. (12.6 KV. MAX.)

Distance from Edge Cm.	100 r	200 r	300 r	500 r	700 r	1000 r	1500 r
2	16 sec.	32 sec.	48 sec.	1 min. 20 sec.	1 min. 52 sec.	2 min. 40 sec.	4 min.
3	20 sec.	40 sec.	1 min.	1 min. 40 sec.	2 min. 20 sec.	3 min. 20 sec.	5 min.
4	25 sec.	50 sec.	1 min. 15 sec.	2 min. 5 sec.	2 min. 55 sec.	4 min. 10 sec.	6 min. 15 sec.
5	31 sec.	1 min. 2 sec.	1 min. 33 sec.	2 min. 35 sec.	3 min. 37 sec.	5 min. 10 sec.	7 min. 45 sec.
6	38 sec.	1 min. 16 sec.	1 min. 54 sec.	3 min. 10 sec.	4 min. 26 sec.	6 min. 20 sec.	9 min. 30 sec.
7	46 sec.	1 min. 32 sec.	2 min. 18 sec.	3 min. 50 sec.	5 min. 22 sec.	7 min. 40 sec.	11 min. 30 sec.
8	54 sec.	1 min. 48 sec.	2 min. 42 sec.	4 min. 30 sec.	6 min. 18 sec.	9 min.	13 min. 30 sec.
10	1 min. 12 sec.	2 min. 24 sec.	3 min. 36 sec.	6 min.	8 min. 24 sec.	12 min.	18 min.
12	1 min. 35 sec.	3 min. 10 sec.	4 min. 45 sec.	7 min. 55 sec.	11 min. 5 sec.	15 min. 50 sec.	23 min. 45 sec.

position, then turning it at right angles to its former position and moving it to the left and right again. The r-units are recorded on the concentric circles which show the distance from the center in centimeters. For example, at a radius of 6 cm. to the right of the center the intensity is 8.8 r-units per minute; along the axis of the tube it is 1.1 and 5.3 r-units per minute; to the left it is 31.2 r-units per minute. Thus it is seen that the field is not uniform. The field at this focal distance has a diameter of 8 cm. which can be considered sufficiently uniform for practical purposes. If a larger field is desired, the distance from the window to the target should be increased, thus increasing the size of the uniform portion.

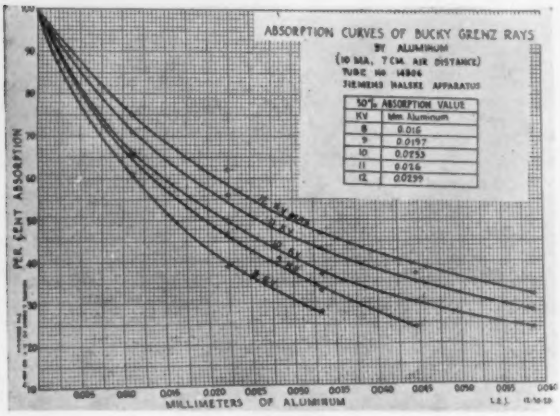

FIG. 13A.

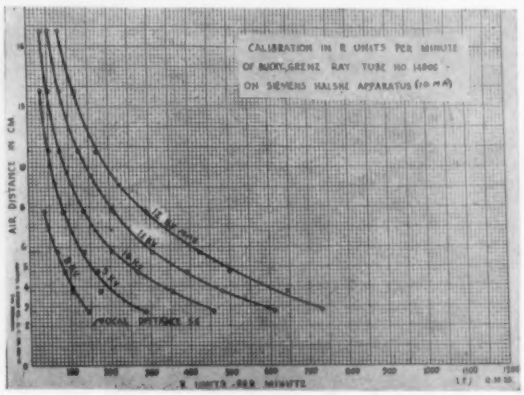
CALIBRATION IN R UNITS PER MINUTE
OF BUCKY GRENZ RAY TUBE NO 14806
ON SIEMENS HALSKE APPARATUS
AIR DISTANCE IN CM
FOCAL DISTANCE 24
R UNITS PER MINUTE

FIG. 13B.

A simpler way of mapping the field is by exposing a photographic plate at the desired distance. Figures 7A and 7B show the comparative size of the field of the same tube at 5 cm. and 10 cm. air distance. The diameter at 5 cm. air distance is 10 cm. and at 10 cm. air distance is about 16 cm. This field is quite uniform. In Figure 8, however, the peripheral portion is different from the inner portion, and only the inner portion can be considered uniform.

VARIATION OF THE HALF-ABSORPTION VALUE WITH THE DISTANCE FROM THE TUBE

The data for the half-absorption value should be taken at the same distance from the tube for very accurate work. But if the grenz-ray chamber is placed within about 10 cm. from the tube the variation in the half-absorption value has been found unappreciable for practical purposes for half-absorption values up to 0.04 mm. aluminum. Figure 9 shows that the half-absorption value is the same for 8 kv. (11.2 kv. max.) at a focal distance of 9 cm. and 20 cm. which is equal to an air distance of 5.4 cm. and 16.4 cm.

The greatest variation found within a distance of 10 cm. from the tube is shown in Figure 10. The half-absorption value at 2 cm. air distance is 0.03 mm. aluminum and at 10 cm. air distance is 0.0325 mm. aluminum. Figure 11 shows the variation in the half-absorption value at 4 cm. and 22 cm. air distance. At 4 cm. the half-absorption value is 0.041 mm. aluminum and at 22 cm. it is 0.0455 mm. aluminum.

TABLE II

COMPARISON OF 50 PER CENT ABSORPTION VALUE IN MM. ALUMINUM FOR SIEMENS TUBE NO. 17763 (10 MA.)

E. M. F. Kv.	50 Per Cent Absorption Value in Mm. Aluminum	
	4 Cm. Air Distance, Mm.	20 Cm. Air Distance, Mm.
7 (9.8 max.).....	0.0205	0.0205
8 (11.2 max.).....	0.0240	0.0270
9 (12.6 max.).....	0.0295	0.0315

Another interesting fact shown by these curves is that the addition of 0.0144 mm. aluminum will increase the half-absorption value for these rays the same as 18 cm. of

air. Similar results were found in many other cases.

Table II shows the change in the half-

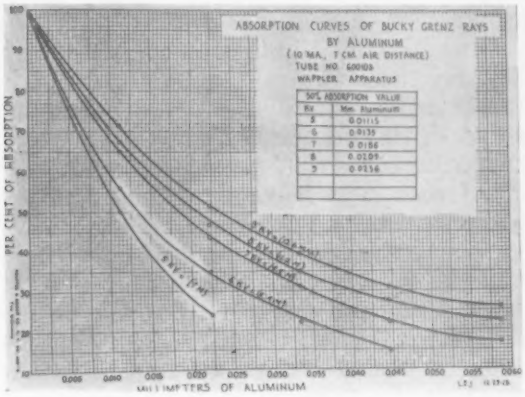

Fig. 14A.

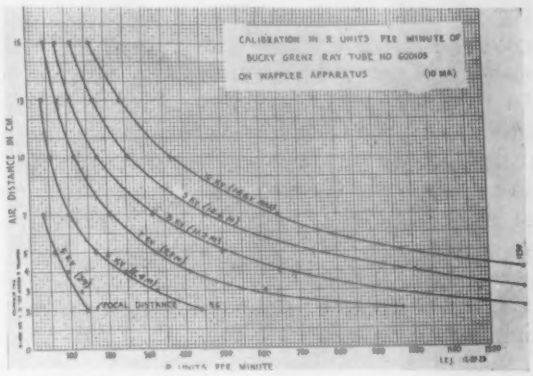
CALIBRATION IN R UNITS PER MINUTE OF
BUCKY GRENZ RAY TUBE NO 60005
ON WAPPLER APPARATUS (10 MA)
AIR DISTANCE IN CM
FOCAL DISTANCE
R UNITS PER MINUTE

Fig. 14B.

absorption value with 16 cm. air distance. For this tube in no case is the difference between the half-absorption value at the two different distances greater than it is between the different kilovoltages at the same distance. For example, for 8 kv. (11.2 kv. max.) at 4 cm. and at 20 cm. air distance the half-absorption values differ by $0.027-0.024 = 0.003$ mm. aluminum. The difference between the half-absorption value of 8 kv. (11.2 kv. max.) and 9 kv. (12.6 kv. max.) at 4 cm. air distance is $0.0295-0.024 = 0.0055$ mm. Al, and this is greater than the former value. In general, the difference between the half-absorption value at two distances increases as the kilovoltage is increased.

Comparison of the Same Tube on Two Different Apparatus. It may be of interest to compare the same tube on two different apparatus. Figures 12A and 12B show the half-absorption curves and calibration curves of a Bucky grenz-ray tube on one apparatus and Figures 13A and 13B give the curves for the same tube on a different apparatus. Table III summarizes the comparisons. The rays produced from this tube at 12 kv. maximum on the Siemens and Halske apparatus have the same quality or half-absorption value as those of 9 kv. (12.6 kv. max.) on the Wappler apparatus. However, the intensities are not the same; the intensity on the Wappler is 580 r-units per minute while that on the Siemens and Halske is 490 r-units per minute. The rays of 10 kv. maximum on the Siemens and Halske apparatus have the same quality as the rays of the 8 kv. (11.2 kv. max.) on the Wappler, yet the intensity of the former is 250 r-units per minute while that on the latter is 390 r-units per minute. Hence we cannot conclude that if two ray beams have the same quality they will necessarily have the same intensities.

Table III

Comparison of the r-units per minute of the same quality ray from the same tube on a Wappler and a Siemens-Halske apparatus: 5 cm. air distance (10 ma.)

50 Per cent Absorption Value on Siemens-Halske	50 Per Cent Absorption Value on Wappler	r-Units per Min. at 5 Cm. Air Distance Siemens-Halske	r-Units per Min. at 5 Cm. Air Distance Wappler
Mm. Aluminum	Mm. Aluminum	r-Units per Min.	r-Units per Min.
0.0299 (12 kv. max.)	0.0297 (9 kv. or 12.6 kv. max.)	490	580
0.0233 (10 kv. max.)	0.0230 (8 kv. or 11.2 kv. max.)	250	390
0.0197 (9 kv. max.)	0.0190 (7 kv. or 9.8 kv. max.)	150	235

Comparison of Different Tubes on the Same Apparatus. Compare Figures 12A and B with Figures 14A and B. It will be seen that the half-absorption value of 9 kv. (12.6 kv. max.) of the former is 0.0297 mm. aluminum and of the latter 0.0236 mm. aluminum. The intensity at an air distance of 5 cm. for tube No. 14806 is 580 r-units per minute while the intensity

of tube No. 600103 is 740 r-units per minute, a difference of 160 r-units per minute or about 27 per cent of the former. We can, therefore, conclude that two different tubes on the same machine under the same conditions of voltage and amperage will not necessarily have the same intensity. In therapy it is unreliable to use the calibration of one tube for another, and since a difference in intensity will sometimes fail to produce the desired effect, the intensity of each tube must be definitely known.

SUMMARY

1. Each tube must be calibrated on that apparatus on which it is used in therapy.

2. For a complete calibration for practical purposes, the following characteristics of the tube must be known:

(*a*) The quality of the grenz rays should be defined by the half-absorption value in aluminum.

(*b*) The intensity in r-units per minute for each kilovoltage and each distance must be known. These data can be recorded on a curve in which distance is plotted against r-units per minute for each kilovoltage. It is useful to prepare a table for each kilovoltage in which the time is indicated for a definite number of r-units.

(*c*) The field should be mapped either in r-units per minute or more easily photographically.

3. For practical purposes the grenz-ray chamber can be placed within the range of 3 to 10 cm. from the window of the tube in order to define the half-absorption value, provided the half-absorption value is about 0.04 mm. aluminum or less.

4. By the addition of the correct thickness of aluminum the quality can be changed, that is, the half-absorption value can be increased to the desired amount.

5. Grenz rays become hardened as the distance from the tube increases as shown by the increase in the half-absorption value at 20 cm. air distance over that at about 4 cm. air distance. The higher the voltage the greater the hardening.

6. The same tube on two different apparatus may have different intensities even for the same quality ray.

7. Two tubes of the same construction, each being used on the same apparatus under the same conditions of voltage and amperage, may have quite different characteristics of quality and intensity.

8. Curves are given which show the half-absorption value for different voltages, different tubes and different distances.

9. Curves are given for a number of grenz-ray tubes which show the variation in intensity, r-units per minute, with distance for different voltages.

10. Diagrams of the fields of grenz-ray tubes are shown.

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THE ACTION OF ROENTGEN RAYS UPON EDER'S SOLUTION

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THE experiments of this paper arise from the search for a chemical reaction to be used as a convenient measure of roentgen-ray dosage. Though no such dosimeter can be expected to replace the customary physical determinations based upon the ionization of air, irradiations must sometimes be made with roentgen-ray sources which are not constant. The satisfactory measurement of dosage is then an integration of the roentgen-ray output over the entire period of an experiment rather than its determination at a particular moment. Such summations are simply accomplished by chemical reactions which proceed quantitatively under the stimulus of roentgen irradiation.

Several accurate studies which seek to interpret certain chemical changes in terms of present-day knowledge of the properties of roentgen rays have appeared. Among these are experiments on the oxidation of ferrous sulphate,[2] on the destruction of hemoglobin,[3] hydrogen peroxide[4] and potassium persulphate. In all these cases conveniently measurable changes are brought about by much greater amounts of roentgen rays than are needed for Eder's solution.

A reaction to serve as a dosimeter must not only be sensitive to relatively small amounts of roentgen rays but it must also proceed to an extent which is strictly determined by the roentgen-ray dosage. At the same time only a very simple and brief analytical procedure should be required for an accurate measurement of its progress. It will be shown that Eder's solution fulfills these conditions.

This solution is made by dissolving corrosive sublimate ($HgCl_2$) and ammonium oxalate [$(NH_4)_2C_2O_4$] in water. Under photochemical stimulation[5] these two substances react together with the formation of calomel (HgCl). This sensitivity to roentgen rays has been known for many years and its use in dosimetry[6] was suggested a long time ago. No quantitative measurements have, however, been published. The reaction proceeds very actively in ultraviolet light and it was supposed to be photosensitive to visible light. Subsequent work has shown that though various metallic impurities, even when present in traces, will sensitize the reaction to ordinary light, solutions made from pure salts are essentially inactive.

The experiments to be recounted in this paper were intended mainly to show whether proportionality exists between the precipitation of calomel and the roentgen radiation striking the solution. For this purpose all measurements were made with a single source of roentgen rays. This was a water-cooled molybdenum target tube of the kind used in crystal analysis. It was operated, with autotransformer control, from a special transformer having one terminal of the secondary at ground potential. Under the conditions of these experiments the maximum variation in the primary voltage applied to this transformer was of the order of 2 per cent. The current (8 ma.) through the roentgen tube, which did its own rectifying, was held constant by heating the filament with an appropriately insulated storage battery. The voltage maintained across the tube was 30,500 r.m.s. volts as measured with a standard 12.5 cm. sphere gap.

The pure chemicals needed to make up a satisfactory Eder's solution were obtained by recrystallizing chemically pure mercuric chloride and ammonium oxalate. Four recrystallizations (from hot water) of $HgCl_2$ and three of $(NH_4)_2C_2O_4$ proved sufficient. Precautions must be taken to insure that these final products remain uncontaminated, especially by traces of iron. Solutions of approximately the desired strengths of $HgCl_2$ and $(NH_4)_2C_2O_4$ were made by weighing out appropriate amounts of the recrystallized salts. These solutions were subsequently analyzed—the

$HgCl_2$ for mercury as HgCl by reduction with H_3PO_3, the $(NH_4)_2C_2O_4$ by titration with $KMnO_4$.

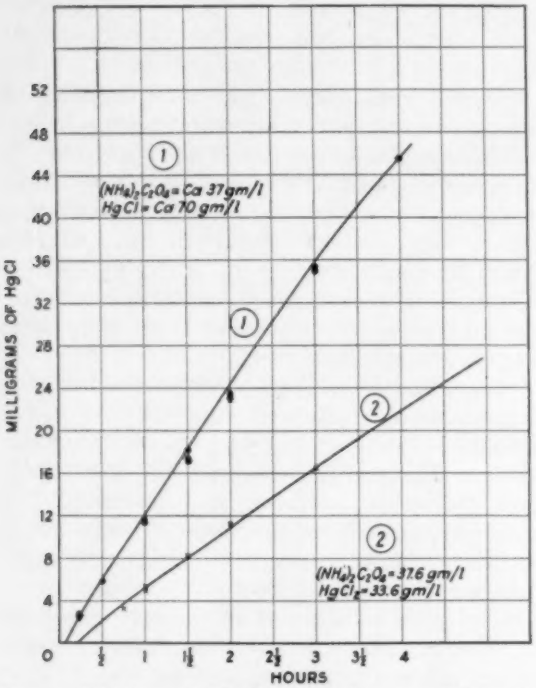

FIG. 1. Weights of HgCl obtained by irradiating for different periods of time two Eder's solutions containing different amounts of $HgCl_2$.

In all experiments the irradiated solution was a freshly made mixture of two 10 c.c. portions accurately pipetted from these solutions of $HgCl_2$ and $(NH_4)_2C_2O_4$. These 20 c.c. were contained in a crystallizing dish roughly 3.9 cm. in diameter and 2.9 cm. deep. In order to prevent excessive evaporation and to protect the solution as much as possible from radiation scattered by various parts of the experimental arrangement, this dish was enclosed in a suitable box of brass and lead. The cover of this box carried two circular openings in lead 3 cm. in diameter and 2 cm. apart; its bottom was of black celluloid. The top was covered by a thickness of photographic black paper to exclude the brilliant light of the cathode filament. The contents of the large lead box enclosing the roentgen-ray tube and the container for the irradiated solution were kept cool with a current of air circulated by a small blower. The only filter used in these experiments was the single thickness of black paper just mentioned. The roentgen rays employed were not therefore strictly homogeneous

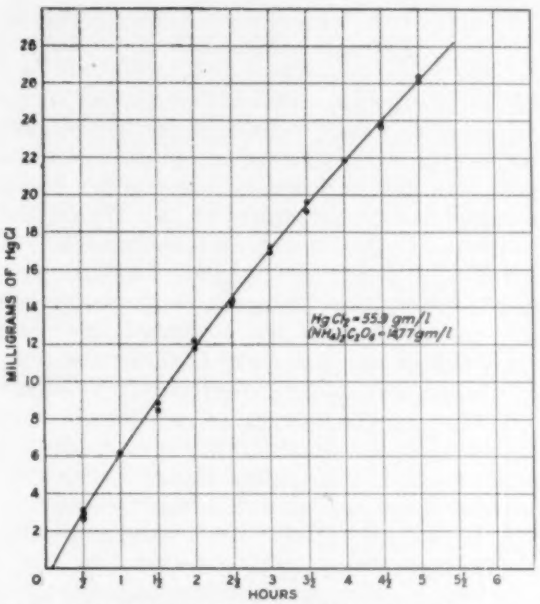

FIG. 2. Weights of HgCl obtained by irradiating for different periods of time an Eder's solution of convenient strength.

but consisted rather of the K series lines of molybdenum superimposed upon a relatively faint but appreciable background of general radiation.

The surface of the irradiated solution was always about 20.5 cm. from the tube target. The approximate ionization of air at this point under the prevailing conditions of experiment was found to be 58 roentgens per minute. This measurement was made with a small ionization chamber[1] of graphite freshly calibrated through a standard air chamber of suitable design.

The chemical reaction brought about by irradiating Eder's solution can be expressed by the equation

$$2HgCl_2 + (NH_4)_2C_2O_4 = 2HgCl + 2CO_2 + 2NH_4Cl.$$

Only slight changes in concentration result from irradiating with beams of ordinary intensity. Accurate estimates of the extent of the reaction are therefore dependent upon measurement of the amounts of precipitated HgCl. Some difficulty was experienced in finding a satisfactory analyt-

ical procedure for this. The one to be described now will, however, give results which are closely reproducible. Essentially the analysis consists in filtering the precipitated HgCl, washing, drying and weighing it. The precipitate due to the roentgen irradiation cannot be collected on filter paper and is too fine-grained to be retained quantitatively in the ordinary Gooch crucible. Satisfactory filtrations can be carried out in glass-bottomed suction crucibles. These crucibles should be of the least porous grade and should preferably be tried out in test runs. About one in four is too porous to give accurate results and must be discarded. The 20 c.c. of irradiated solution with its precipitated HgCl is poured upon this filter and the retained precipitate washed with the smallest possible amount of water saturated with HgCl. This washing must be particularly thorough since the original solution contained large quantities of $HgCl_2$ and $(NH_4)_2C_2O_4$. Experience shows that by carrying out successive washings with 5–10 c.c. portions, a total of about 50 c.c. is sufficient for the average precipitate. The resulting crucible with washed precipitate is then dried, first for two hours or more in an oven of about 70°C. and then in a 103–108°C. oven for thirty minutes. The precipitate-bearing crucible is finally weighed after cooling in a desiccator. It is customary in quantitative practice to dry HgCl directly by a single and prolonged heating at 110°C. This cannot safely be done when the total amount is only a few milligrams.

Several series of determinations are summarized in Figures 1 to 3. There is reason to believe that some of the differences between duplicate runs in these experiments are to be ascribed to real variations in dosage arising from small voltage fluctuations during the runs. Less extensive but similar results have been obtained using a tungsten tube operated at 40 kv. and 70 kv. peak.

Until appreciable changes in concentration commence to occur with very long times of irradiation the curves of Figures 1 and 2 are substantially straight lines. They do not, however, pass through the origin. The induction period which is thus indicated is apparently accounted for by the slight solubility of HgCl in water. For many purposes it is sufficient to use the rectilinear parts of these curves and to

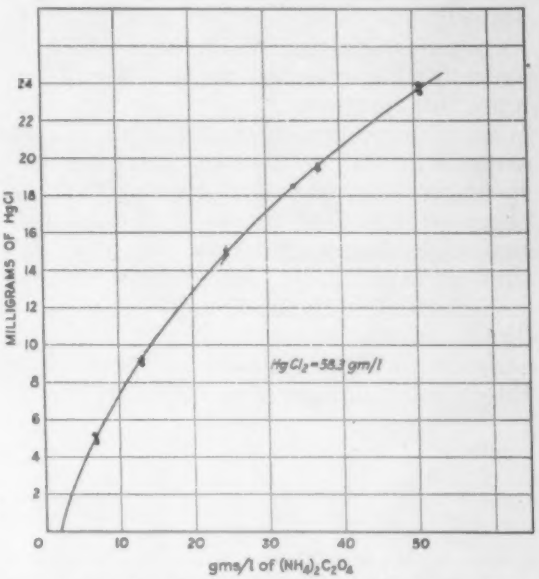

FIG. 3. Weights of HgCl obtained by irradiating Eder's solutions made with $(NH_4)_2C_2O_4$ solutions of different concentrations. The uniform time of irradiation was two hours.

establish their slopes for the particular strengths of Eder's solution that are used through a pair of carefully controlled irradiations. After more work with different qualities of radiation it would be feasible to write down expressions of sufficient accuracy for the amount of HgCl to be expected through the irradiation of different strengths of solution with rays produced at different voltages. The extent to which such expressions would be empirical would of course depend upon the degree of success which attended efforts to interpret the mechanism of this reaction.

The roentgen rays we have used are very strongly absorbed in Eder's solution. This absorption, which is largely due to its content of mercury, would be expected to lead to a pronounced dependence of amount of precipitated HgCl upon concentration of $HgCl_2$ in the solution (see Fig. 1). The observed (Fig. 3) variation in precipitate with concentration of $(NH_4)_2C_2O_4$ is not, however, due to differences in amounts of absorbed energy but must find its explanation in the intimate mechan-

ism of the reaction. Photochemical studies have made it clear that for ultraviolet stimulation[5] this mechanism is not simple. A consideration of the results of this paper leads to a similar conclusion for roentgen irradiation. We hope, however, to make further experiments which will bear upon this question.

As a consequence of the study of the decomposition[2] of ferrous sulphate with roentgen rays, it was suggested that this chemical action is the result of the formation of hydrogen peroxide. Not only is a similar explanation for Eder's solution incompatible with the data of Figure 3 but direct experimentation shows that the addition of small amounts of peroxide to Eder's solution does not precipitate HgCl.

SUMMARY

Determination of the amount of HgCl precipitated from a mixture of $HgCl_2$ and $(NH_4)_2C_2O_4$ by roentgen irradiation offers a simple and accurate chemical means of estimating the amount of this irradiation. An analytical procedure which gives an accurate determination of HgCl in such solutions is described and typical curves are reproduced showing the relation between the weight of precipitated HgCl and the amount of the incident roentgen radiation.

This reaction has provided a convenient dosage-meter for certain studies of the chemical effects of soft roentgen rays where it was impossible to employ outfits of strictly constant roentgen-ray output.

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SOME PRECAUTIONS TO BE TAKEN WHEN MAKING TESTS FOR RADIOACTIVITY IN THE LIVING BODY

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SCHLUNDT, Barker and Flinn in a recent issue of this Journal[2] described a procedure for the detection and estimation of radium and mesothorium in living persons. Work in my laboratory has indicated the necessity for certain precautions that must be taken when making these observations if very small amounts of radioactive substances are to be detected in the living body.

When I first began my study of the detection of radioactivity in the living body in August, 1925 (not as Martland[1] has recently stated, in 1927) it was the rule in my laboratory to determine the natural leak of the Wulf-Hess quartz fiber electroscope by having a person who had never been exposed to radium placed in the same position and distance from the electroscope as the suspected person would be placed.

In the Spring of 1928, while examining a group of persons in a hospital this precaution as to the use of a control person was omitted as it was not considered necessary at that time by the group of experts

present. Among the persons examined was one who had been tested in my office in 1926 and whose body at that time was found to contain approximately 12 micrograms of radioactive material as estimated by the Wulf-Hess gamma-ray electroscope. In the test made in 1928, she was found to be negative which was rather surprising, but because of the legal situation difficulties were placed in the way of making a proper re-examination of the group when certain irregularities were noted. Several months afterwards this person was again examined by other investigators using my electroscope and she was again found to be radioactive.

For a while, I continued making tests without the use of the control person,—that is, making the natural leak by placing the electroscope in the same position as when examining a suspected person but without any one sitting in the chair. A number of so-called negative results began to be recorded. By "negative results" I mean the suspected person would be found to give a lower reading with the electroscope than the readings made for the natural leak. The differences were greater than could be accounted for by experimental error. Inquiries among persons qualified to make electroscopic tests brought forth various explanations of this phenomenon such as that the body screened off some of the rays from radioactive material that might have been present in the room. It was suggested by one well-known authority that it was probably due to the screening out of cosmic or Millikan rays by the body. These explanations while plausible did not satisfy me. We feel that we can now offer some explanation for at least part of these erroneous results.

We are giving below some of our readings with the Wulf-Hess electroscope which are self-explanatory. The readings were all made on persons who had had no radium exposure and were taken in an inside room having no windows or openings to the outside. The temperature of this room remains practically constant throughout the day. The observations were made on different days which indicate that the observations are not erratic readings.

March 28, 1929.

	Scale Divisions	Time	Drift Divisions per Second
Chair empty	60–55	24′ 2″	0.00346
Girl in chair	60–55	24′ 53″	0.00334
Chair empty	60–55	23′ 58″	0.00347
2d girl	60–55	24′ 54″	0.00334
Chair empty	60–55	24′ 13″	0.00344
May 1.			
Chair empty	60–55	23′ 51″	0.00349
Girl in chair	60–55	22′ 53″	0.00369
Chair empty	60–55	24′ 00″	0.00347
May 9.			
Chair empty	56–51	20′ 32″	0.00405
Man in chair	56–51	22′ 33″	0.00374
Placed corrugated card board between electroscope and man for insulation.			
	56–51	20′ 26″	0.00407
Girl in chair without insulation	56–51	23′ 40″	0.00352
Chair empty	56–51	20′ 25″	0.00408
Girl in chair with insulation	56–51	20′ 00″	0.00417
May 10.			
Chair empty	60–55	24′ 55″	0.00341
Bottle containing 2 liters of water having a temperature of 10°C. placed in same position as occupied by girl.			
	60–55	22′ 33″	0.00369
Temperature of water increased to 36° C.			
	60–55	25′ 33″	0.00321
Chair empty	60–55	24′ 13″	0.00341
May 22.			
Chair empty	60–55	21′ 15″	0.00392
Girl in chair	60–55	22′ 20″	0.00373
Chair empty	60–55	20′ 55″	0.00398
Girl in chair with insulation			
	60–55	19′ 57″	0.00418

A study of these readings indicates clearly that the heat of the body will affect the drift of the electroscope unless care is taken to provide some kind of insulation between the body and the instrument. Different persons might affect it differently, depending on their skin temperature at the time. These readings are also proof that groups of persons must not collect around the machine while the drift of the machine is being made. The differences between the readings made with some one sitting in the chair and the empty chair, it is true, are comparatively small, and under ordinary conditions in the measurements of relatively large amounts of radium would be unimportant. Some observers might go so far as to claim that they come within experimental error, but the fact that there is always a difference discounts this statement.

In testing employees in the radium

industry one is often dealing with very small amounts and the differences shown in the above figures might account for from 2 to 6 micrograms of radioactive material. This is particularly true in examining the children of radioactive mothers. My examination of some of these children has shown them to be radioactive although the amounts were less than 10 micrograms.

There is another precaution that should be taken to assure correct readings where small amounts of radium are to be tested for. The instrument should be taken to the place where the test is to be conducted the night before so that it can become acclimated to the new surroundings. In the test made at the hospital in 1928, the instrument was taken there at the hour the examination was to be made. In looking over my figures taken at that time one must be impressed with the very high natural leak which was found, 0.015100 divisions per second. This is from three to four times the natural leak found consistently in my laboratory, as can be seen from the figures given above. This greater number of divisions per second tends to lessen the sensitiveness of the instrument. While making the readings on the group a sudden drop from 0.01600 to 0.01397 divisions per second took place, indicating that the conditions present were unstable.

However I believe that if the precautions suggested as to the use of insulation between the person and the instrument are taken; if the instrument is allowed to become acclimated; if no one is permitted to be present except the person being examined and the person or persons making the readings; if precautions are taken to avoid any direct or indirect heat from the sun's rays, the method previously described in this Journal[2] is very reliable. This of course presumes that all other conditions remain constant in the place of examination.

It has been definitely shown that there is a natural minute elimination of radioactive material taking place daily. The mere fact that a girl's body is found to contain very small amounts of radium after being away from the exposure for years does not mean that at one time it did not contain more. This is all the more reason why particular care should be taken to detect the extremely small amounts that may be present in the body. It is my contention that if radioactivity is found, no matter how small, with a history of past exposure and a suspicious clinical picture it should be considered and treated as a "radium" case.

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NEWER METHODS OF APPLYING RADIUM

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IN the paper by Regaud which appeared in this Journal,[1] this statement is to be found: "The radium therapy of all cancers arising within natural cavities of the body is complicated by the following difficulties: Access for radiation is available only to the central part of the neoplasm, i.e., the part immediately in contact with the radiating focus; the cavities of these invaded viscera are narrow and can be dilated only very slightly, especially as the mucous membrane is usually thin and vulnerable. These difficulties bring about inexact application, danger of over-irradiation and burns of the parts near the radiating focus, especially if strong doses are used, and under-irradiation of distant parts if a weaker radiation is employed. Homogeneous distribution of radiation throughout the neoplasm by this method is possible only if the thickness of the neoplasm is so inconsiderable that the outlying portions of the neoplasm may be reached with a fairly equal dose, by irradiation from within the cavity."

Further on, we come upon this statement: "The introduction into the tissues of radium in containers . . . may be carried out by several methods: Inserting and permanently leaving within the tissues minute capillary tubes containing radon . . . There are several objections to this method . . . The radiation coming from the seeds acts as a diffuse caustic and frequently produces early or late necrosis of the treated tissues. While this objection has been partly overcome by the substitution of gold for . . . glass . . . the thickness of the gold should be increased to 0.4 or 0.5 mm., if principles of radiotherapy are to be followed to their logical conclusion. It may also be questioned whether such foreign bodies as seeds may be left permanently in the tissues with impunity. Accurate and uniform spacing of seeds, which is essential for homogeneous irradiation, is difficult, except in small and thin neoplasms."

[1] Regaud, Cl. Radium therapy[1] of cancer at the Radium Institute of Paris. Am. J. Roentgenol. & Radium Therapy, 1929, xxi, 1–24.

These quotations embody truths which no radium therapist is in a position to deny. Granted the conditions which Regaud postulates, the results he deplores will inevitably follow. However, since this address was prepared, considerably more than two years have elapsed, and even at the time Regaud delivered it, "the principles of radiotherapy" had been extended somewhat beyond the bounds to which he limited them. New though the science of radiotherapy is, it has taken on the most salient characteristic of that other science to which it is most closely related—medicine. In the very infancy of its development it is already becoming conservative, and on every hand we find evidences that it is clinging obstinately to what has been accomplished in the past as an unassailable criterion of what we may be able to do in the future. The true scientific attitude is justly critical and conservative, but it is likewise open-minded in examining and testing every advance which has been made from its conservative position. If this were not so all scientific progress would be impeded or entirely halted.

It is my present purpose to point out certain technical changes which my personal experience leads me to believe are definite steps forward in the science of radium therapy, and to endeavor to show that some of the greatest handicaps to successful radium treatment as outlined by Regaud, have already been overcome. "Homogeneous radiation throughout a neoplasm" has actually been attained without "over-irradiation and burns of the parts near the radiating focus," and it has been repeatedly demonstrated that the radiation from implanted seeds does not necessarily "act as a diffuse caustic," nor is its sequel invariably "radio-necrosis of the treated tissues."

For a number of years it has been possible to obtain and implant radon seeds having a screenage of 0.3 or 0.45 mm. platinum and this, according to the experimental results of Regaud's own colleague, Lacassagne, is entirely adequate to prevent

tissue necrosis when the radon content of the tube so screened does not exceed 7 millicuries. The objection relating to the impunity with which such radon applicators may be left in the tissues was long ago met by making these seeds removable. The thread which is attached for this purpose likewise serves to mark the position of the seed immediately it is implanted, thus rendering easy the accurate and uniform spacing of seeds.

There are now but few malignant lesions which cannot be better treated by implantation than in any other way. The French radium therapist's dictum that "homogeneous irradiation by interstitial methods is best obtained by radium puncture with the use of removable platinum needles" requires only the alteration of a single word—the substitution of "seeds" for "needles"—to make it a complete statement of the present situation in regard to therapeutic radiation. Improved implantation instruments and better diagnostic methods have made "seeding" applicable to a number of situations where it was until recently, regarded as wholly out of the question.

A striking example of this is the employment of removable platinum seeds in advanced carcinoma of the uterine cervix. For early and moderately advanced cervical carcinoma the methods of radium application devised by Regaud and other French workers have proved so eminently satisfactory that no attempt to supplant them by any other system has been even contemplated. With the cases coming under observation only in the later stages it has been quite otherwise. When malignant infiltration of the broad ligaments and vaginal vault has already taken place, surgeon and radium therapist alike have merely shaken their heads, usually refusing —and with perfect justice—to attempt even palliation by any other means than ever-increasing doses of narcotics. But early in the development of the implantation method, even before screened seeds were available, some pioneers saw a chance of alleviating the sufferings of women so afflicted by "cleaning up" the surface manifestations of malignancy by bare tube implantation. Though the sloughing following these caustic applications was often considerable, and the fatal outcome apparently but little delayed, great relief was frequently obtained by both the patient and those who were charged with her care. By keeping the dosage in each seed very small, and producing as little necrosis about each center as was possible, fistula formation could generally be avoided. Thus, though regarded purely as a palliative measure, implantation found a place in advanced cervical carcinoma.

With the introduction of screened removable seeds the indications were greatly extended. As anatomically the extent of a malignancy in this region is comparatively easy to estimate provided it has not passed beyond the parametrium, it became possible for a skillful operator to place seeds throughout the extensions of the growth around the cervical canal, and by the use of specially designed instruments to distribute the radiation accurately even in tissue as difficult to handle as that presented by advanced malignancy in this area. With adequate filtration the radon content of each seed could be increased enough to give higher dosage from the individual centers than had been possible with the older methods. This lessened the number of seeds to be implanted and thereby diminished the chances of trauma which had hitherto been a serious drawback in any work of this kind. The method has proved so successful that many women who would formerly have been condemned to speedy death, have been accorded a chance of life equal to that of patients coming under treatment in the incipient stages of the disease.

Not the least of this technique's recommendations is its simplicity. It can be carried out in any hospital, requiring no special equipment or elaborate apparatus. The seeds themselves, as well as the implantation instruments, gauged to permit deposit of the seeds at previously selected depths, are readily procurable, and granted the gynecological skill which is a prerequisite of any method of treating cervical carcinoma, there is no reason why it should not be available to every woman who has need of it.

In regions formerly regarded as inaccessi-

ble to radium treatment the use of these removable platinum seeds has proved practical and successful. The esophagus and rectum are examples of such locations. For esophageal work I have designed a modification of the esophagoscope particularly adapted to implantation. Such specially designed mechanical aids are not, however, absolutely essential. Laryngologists working with radium have employed their regular instruments with equally satisfactory results. The treatment of patients suffering from cancer or the esophagus has proved especially worth while, for the existence of this lesion—more than any other malignancy—formerly condemned a man to speedy death with practically no hope even of alleviation. As cancer of the esophagus is—fortunately—a rare malignancy, the number of patients who have so far received the benefits of this form of therapy is not large. Yet the progress of those to whom it has been applied has been watched with great interest, and reports from such widely separated centers as the Lenox Hill Hospital in New York and the Hajek Clinic in Vienna, are so favorable as to offer great encou agement for the future.

As cancer of the rectum is a relatively common cancerous lesion, the opportunities for application of the implantation method and the observation of its results have been far greater than is possible with the rarer manifestations of the disease in the esophagus. The therapeutic problem presented is, however, similar in many respects. Implantation must be done through an endoscope, and the necessity of "keeping track" of the exact location of each seed as it is put in place, is paramount. The seed-thread must be cut off before the seed is placed in the loading-slot of the implanter until no more than 2 cm. length is allowed to protrude. This is enough to grasp with the forceps when the time comes for withdrawal of the seed, and is likewise ample to mark the spot where the seed was implanted. Yet it is too short to carry danger of becoming entangled in any material passing through the lumen of the digestive tube—esophagus or lower bowel, as the case may be—with resulting dislodgment of the seed before the desired period of irradiation is concluded. In certain criticisms of the removable seed which have appeared in medical literature during the past year or two, this danger of dislodgment has been greatly over-emphasized, and writers have drawn gloomy pictures of whole skeins of thread hanging down in the lumen of the canal, ready to emesh anything that passed by them, a situation these authors appeared to believe was infinitely more dangerous than the permanent abandonment of sharp-pointed foreign bodies in tissues as susceptible to irritation as those composing the walls of esophagus and rectum.

Leaving the seeds permanently in the tissues presents another problem aside from the dangers and inconveniences of a retained foreign body. The necessity of affording perfect physiological rest for these tissues has not, in the past, been dwelt upon with sufficient emphasis. Theoretically, radium emanation ceases to be active after a given decay period has elapsed. Actually, long after the expiration of this period, a very small but nevertheless by no means wholly negligible, amount of radiation is still given off from the seed, which continues to exert a slightly irritating influence for an indefinite time. When we consider the nature of malignancy and the importance of removing all factors inducing irritation from an area where a neoplasm has once arisen, this "negligible" residual radiation assumes considerable importance.

A word might also be said here concerning the dangers of infection travelling along the threads, a point which has likewise been brought forward as greatly limiting the usefulness of removable seeds. This objection probably has its greatest force when the seeds are to be placed in such an infectious area as the mouth or rectum. Theoretically such a path of infection is prefectly logical; practically I have never seen any such infection occur. In malignancies of the cheek, the "root" of the tongue, and the tonsil or larynx, implantation is readily carried out externally, and this route is for many reasons to be preferred, even if we wholly ignore the possibility of infection being conveyed

to the tissues by the protruding threads. Moreover, if any practitioner is impressed with this hypothetical menace he can still make use of the advantages of platinum filtration, even while rejecting those of removing the foreign body danger. The platinum-filtered seed, if left permanently in the tissues, will not produce mechanical irritation in any position where a foreign body can be tolerated at all, because its ends are absolutely rounded and smooth. In prostatic work, for example, most operators think it has proved better to omit the removable feature, and none of them have reported inconvenience from the permanent retention of the seeds in the irradiated tissue. It is still my personal opinion, however, that complete removal is the wisest course, whenever it is possible to follow it out.

PROVED COMMUNICATION BETWEEN THE LEFT URETER AND THE SMALL INTESTINE . . . CAUSE UNDETERMINED

CASE REPORT

BY GERARD RAAP, M.D.

Roentgenologist, Gowdy Hospital

MIAMI, FLORIDA

ABNORMAL communications between various viscera of totally unlike function usually find their explanation in untoward complications of surgical procedures, localized infective processes with extension, gross trauma, or congenital aberrations. They may be surgical intentions in certain necessary instances. In artificial ureteral implantations the prognosis as to efficacy of function and duration of life is problematic. We deem it of interest, therefore, to report a case in which such implantation appears to be of questioned origin, and in which the roentgen and autopsy findings certainly offer choice as to cause. It also shows that a patient of more than average intelligence may live for as long as six years, with practically all of his urine passing into the small intestine without his knowledge of the exact situation, and apparently in perfect health.

The roentgen findings in this case were reported to another journal previous to securing the autopsy findings, and were returned to us with a notation, "Probability of this condition very doubtful." Since the autopsy protocol corroborates the twice repeated examination, we again call attention to it.

Mr. S., aged thirty-three, was referred to us by Drs. Flipse, Holmes and Coplan for roentgen examination. He had the appearance of a pale, undernourished individual of a rather neurotic type, but was apparently able to carry on clerical work, and seemed well above the average in intelligence. His history is as follows:

In 1916, while in France, a 6 inch shell exploded sufficiently close to throw him 20 feet, burying him under a pile of rock. He was unconscious for three days, and diagnosis was made of fracture of the left humerus, left clavicle and several ribs on the left side. The entire left side of the body was markedly contused and lacerated, and almost immediately after regaining consciousness he noted a dull, throbbing ache in the left half of the lower abdomen. The only urinary symptom at this time was slight frequency. The pain in the left lower quadrant continued, and upon consulting a Pittsburgh surgeon about one year later a diagnosis of intestinal stasis was suggested and mineral oils and other evacuants prescribed. This produced no relief, and upon exploratory laparotomy he was informed that there were a number of adhesions and a Lane's kink, but that the appendix was apparently normal. On the third day after operation there was severe pain in the operative wound, and a sudden discharge of a large quantity of urine from the wound, together with pus. This continued for five weeks.

During the first three weeks he was catheterized at regular intervals, and for the next

two weeks a retained catheter was employed, The external fistulous opening closed, and the patient found that he could urinate only through the urethra he stated that this did not occur. The first two hours in the morning after rising there were at least three or four

Fig. 1.

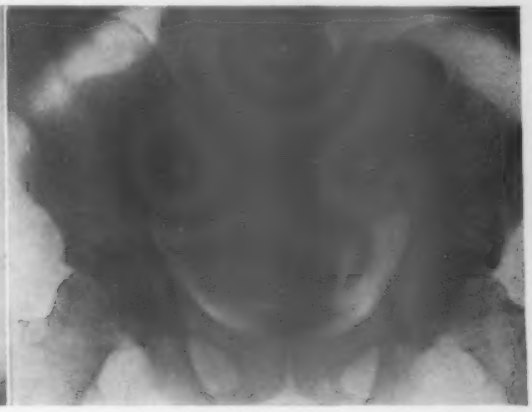

Fig. 2.

while lying on the left side. A later examination with attempt at cystoscopy, both with and without anesthetic, was entirely unsuccessful, and the urologist stated that it was impossible to introduce a cystoscope on account of inflammation between the bladder and the rectum. Hot colonic irrigations were ordered, and after one of these the patient stated that he felt something "break loose," and immediately thereafter he passed several teacups of pus through the urethra. After that time the stools gradually became more fluid. At the time of our examination he passed practically all of his urine through the rectum, and only rarely was there any urine evacuated through the urethra. He called attention to the fact that occasionally small seeds and other food particles were passed through the urethra, but when asked about passing air evacuations, with one or two later in the day. The desire to evacuate was usually preceded by discomfort in the anterior abdomen.

Cystoscopic Findings by Dr. Holmes—under Gas Anesthesia. A cystoscope was introduced with difficulty on account of marked induration of the tissue between the bladder and rectum. The size of the bladder was apparently not much less than normal. The dome was markedly indurated and flattened. On the right side, corresponding to the position of the right ureteral orifice, a golf hole opening was observed about six times the normal size. It was thought to be a diverticulum, but upon investigation the catheter passed directly upward, apparently without contact with the walls of the ureter. Specimens were practically free from pus. A pyelogram was made with the following report:

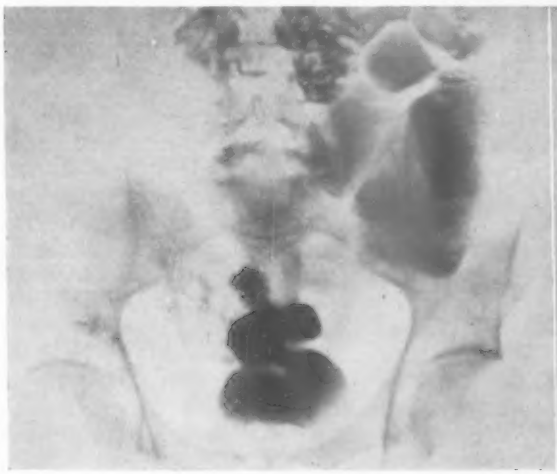

Fig. 3.

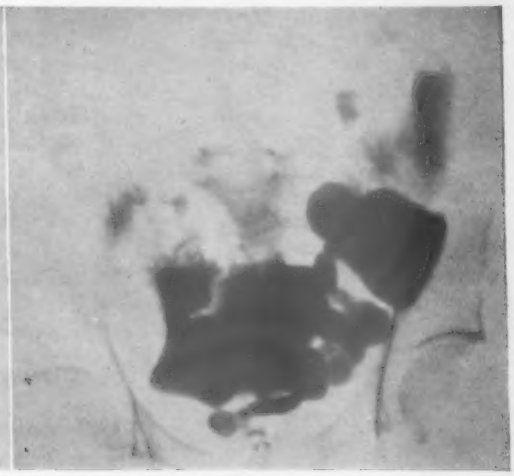

Fig. 4.

The right kidney is enlarged by about 50 per cent. The calyces are somewhat obtunded, and the pelvis enlarged, while the ureter is definitely dilated throughout (Fig. 1). These evidences were considered suggestive of an early hydronephrosis. Phthalein function of this kidney was apparently about 50 per cent normal. Upon search for the left ureteral orifice a large golf hole opening, several times larger than that seen on the right side, was noted. Attempts at exploration in search of the left ureter were unsuccessful, and with the impression that just as on the right side, the left ureter probably emptied into this pouch, it was thought impossible to introduce a catheter into the left ureter. The bladder was then injected with sodium bromide, and the following roentgen findings were noted:

The shadow of the bladder is represented by a small irregularly outlined area, just above the level of the symphysis. From it there extends upward on the left side a curved shadow about one-half inch in width, the course of which corresponds with the left ureter. At the level of the middle of the sacroiliac synchondrosis there is a shadow which has the outline characteristic of a dilated small intestine (Fig. 2). Later a barium enema was given and evacuated to outline the colon (Fig. 3).

Lipiodol was then injected into the bladder, and observed under the roentgenoscope. It progressed from the bladder into what was apparently the left ureter for a distance of about 5 inches, then into the ileum, and from the ileum into the cecum, filling it to the level of the ileocecal valve (Fig. 4). A diagnosis was made of communication between the left ureter and the ileum, hydronephrosis and dilated ureter, reflux into the left and right ureter.

Fifteen minutes after each of these procedures, the patient complained of severe abdominal colic, and evacuated the contrast materials through the rectum.

He declined surgical investigation, and was later transferred to the United States Veterans' Hospital at Lake City, Florida.

Several months later, on December 23, 1927, an autopsy protocol was written by the pathologist of Walter Reed Hospital, and forwarded for our records, the salient post-mortem notes of which are as follows:

"On the peritoneal surface there are adhesions running to the omentum and the transverse colon, binding it to the cecum and appendicial region. The latter is firm and perfectly healed. The ileum, exactly 46 inches above the ileocecal valve, is firmly attached to the wall of the urinary bladder. The mesentery of this loop of the gut has acted as an internal band, and a portion of the ileum between the attachment and the valve has undergone a semi-vólvulus, with a certain amount of obstruction beneath the band described. This has caused this portion of the gut to puddle permanently in the pelvis, so that the sigmoid and the rectum are pushed over in a sort of compartment to the left side. A small part of the upper sigmoid is also attached at the position of the bladder and ileum union. The obstruction of the ileum is not complete, but has amounted to a certain interference with the intestinal flow, and at the same time a moderate amount of passive congestion of the mesenteric vessels of the portion obstructed, producing a glazing of this portion of the gut.

"The bladder is contracted against the pubic bone and held by dense adhesions over a centimeter thick. This was especially apparent during removal. Upon section the bladder wall is contracted so that the cavity is about 3 to 4 cm. in width. The mucosa is deeply reddened and bluish.

"Midway between the ureters and just above the trigone, a fistulous opening, 1 cm. in diameter, extends directly into the loop of intestine described as adherent. As a result of this condition the bladder has been functioning very little as a cistern but the urine has been draining immediately into the ileum. The opening of the left ureter is not obstructed, is easily found, and immediately the ureter dilates until it measures over 1 cm. After incision this extends all the way to the kidney, with a sharp angulation as it passes under the spermatic vessels. The pelvis of the kidney is also distended. The stoma of the right ureter is also easily found and opens into a ureter slightly dilated but not as marked as on the left side. The pelvis of the right kidney is not distended. The obstruction on the right side is due to extreme fibrosis of the bladder wall and not to any angulations or dilatations.

"The left kidney is bound down by densely firm adhesions and no perineal fat. The capsule is thickened but strips easily. The organ is extremely flabby with marked loss of structure, it being elongated and sausage-like in shape. Upon incision the cut edge bulges distinctly. The dilatation of the pelvis produced a relative decrease in size of both cortex and pyramidal portions. The cortex is pale and markedly granular as compared with the deep blue of the pyramidal portion. The left kidney has one large, white, well-circumscribed area filled with soft purulent material in its upper pole, and several smaller areas not as well circumscribed. The right kidney is quite similar to the left, except that the loss of structure is not quite as apparent, while the degenerative condition is similar."

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CHARCOT'S DISEASE OF BOTH HIP JOINTS

CASE REPORT

BY L. P. McCALLA, M.D., AND A. M. WARREN, M.D.

BELLINGHAM, WASHINGTON

MR. C. M., aged fifty-six, rancher. At the age of ten had rheumatism and at the age of twenty-one contracted syphilis and was placed on antisyphilitic treatment. A few years later he took one course of intravenous injections, which he was told was "606." On June 28, 1917, he was injured in a runaway and sustained fractured ribs. In March, 1918, while out on his ranch, his left hip gave way and he was unable to walk. The attending physician diagnosed the case a dislocated hip and he was confined to his bed for three months. He was then up and around and could walk with the aid of cane. Almost exactly one year later, the right hip gave way and the same diagnosis of dislocated hip was made. Following this injury he was confined to his bed for nearly a year. He was then able to get about with the aid of crutches. While alighting from a street-car, Nov. 1, 1928, his crutches slipped and he fell sustaining a fracture of the patella and was removed to the hospital. While confined there he requested that roentgenograms of his hips be taken as they were both dislocated.

FIG. 1. Roentgenogram of the pelvis showing the complete destruction of the heads of both femora, with upward dislocation of the femoral shafts and the creation of new acetabular cavities above the normal position. There is considerable bony detritis about the hip joints with bony exostoses extending out from the ilia on either side.

The roentgenogram (Fig. 1) shows the condition found and diagnosed as Charcot's disease, both hip joints. He is up and about again and is able to walk short distances with the aid of crutches.

FIG. 2. Lateral roentgenogram of the knee showing fracture of the patella.

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Information of interest to all readers will be found on page ii.

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EDITORIALS

MEMBERSHIP IN THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The American Roentgen Ray Society has recently been honored by admittance to membership in Section N (medical section) of the American Association for the Advancement of Science. This Association is a great democratic organization that operates, without financial profit, to further the advancement of science in all branches. Through its meetings and through its publications it promotes the feeling of fellowship among men and women of science and all who are interested in the progress of knowledge and education. The Association is especially interested in facilitating the spread of scientific knowledge and the appreciation of scientific work among all the people. It is also a great association of independent American scientific organizations and thus furnishes a valuable means for their mutual cooperation in the advancement of science as a whole. Many of the officially associated societies meet with it either regularly or occasionally, the facilities of the Association being always at their disposal when they meet with it. A large number of associated societies are officially affiliated, with representatives in the council of the Association, thus taking part in the management of its affairs. There are now 119 officially associated organizations of which 88 are officially affiliated, including 23 affiliated academies of science.

The Association offers the most efficient means by which individuals, scientific societies, and scientific institutions may unite to hasten the growth of scientific knowledge and to increase public appreciation of what the peoples and nations owe to science and what may be expected of science in the future. The insistent efforts of many individuals and organizations, united in such a comprehensive association for the advancement of learning, is capable of exerting a most powerful influence for good in the national and international development.

The annual meetings of the Association are held at the time of the Christmas holidays. The attendance is counted in thousands and from one to two thousand papers are presented, in nearly all fields of science. The Science Exhibition is an important part of each meeting. Everyone interested in science and education should attend the annual meeting. The next meeting will be at Des Moines, from Friday, December 27, 1929, to Thursday, January 2, 1930, under the presidency of Doctor Robert A Millikan, eminent physicist of the California Institute of Technology, which latter fact should make the 1929 meeting of especial interest to roentgenologists. The preliminary announcement of the Des Moines meeting will appear in *Science* for November 29 and copies will be sent free to all who request them.

THE ULTRAVIOLET RAY IN THE FIELD OF ART

While roentgen rays have been used extensively in determining the antiquity of paintings, it is of interest to learn that now the ultraviolet ray is being tried out experimentally in another field of art. It is believed that the Metropolitan Museum of Art in New York City is the first to study the value of the ultraviolet ray in this connection. The work thus far has been confined to the determination of the age of marbles, an interesting account of which is given by Mr. James J. Rorimer,* assistant in decorative arts at the Museum, as follows:

In determining the age of works of art, and particularly in detecting the spurious antique, certain chemical and physical tests have been developed in recent years to supplement the so-called "sixth sense"—that quality which connoisseurs must possess.

* Rorimer, James J. Marble sculpture and the ultra-violet ray *Bulletin of the Metropolitan Museum o Art*, July, 1929.

In addition to the microscope and the chemist's laboratory equipment for both organic and inorganic analysis, the x-ray, and now more recently the ultra-violet ray, are coming into use.

The invisible ultra-violet rays which are at the cold end of the solar spectrum can be produced by the use of a mercury vapor arc in quartz, and by the additional use of a filter, which cuts off all but a very small band of the invisible ultra-violet rays, a powerful light is obtained. When objects are exposed to this light they tend in varying degrees either to fluoresce[1] or to reflect the purple rays. In the case of fluorescence, substances which under normal conditions are white might appear yellow, blue, or any other color when exposed to ultra-violet light.

Perhaps no works of art through the ages have been so sought for and cherished as fine marble sculptures. The temptation to produce forgeries, to copy, or to repair has attracted skilful artists and artisans. For this reason, in the study of the physical characteristics of museum exhibits,[2] no material seemed to offer more interesting possibilities than marble.

With continued exposure to the elements, the surface of marble is changed, and gradually, because of penetration from the surface, chemical action proceeds a short distance into the body of the marble. We might, therefore, expect that the appearance of old marble under the violet-ray would be different from that of freshly cut marble (or old marble which has been recut) whose surface has not been changed by chemical action, and this, in fact, has been demonstrated by experiments conducted in the Museum.

Pieces of freshly cut Carrara marble, the purest form of white marble (calcium carbonate), used most extensively for objects of art since the quarries were first worked by the Romans in about 173 B.C., were exposed to the ultra-violet rays. Old marble was then examined. Between the two there was a decided difference in color under the rays. Certain conclusions resulted which would seem of great importance in determining the age of marble.

After additional preliminary experimental work with marbles of various periods, a group of test examples was submitted by the Classical Department. In all cases the conclusions based on the use of the ultra-violet light were identical with those which had already been reached either on external evidence or by reasons of style. Both old and new pieces were submitted without any information whatsoever concerning the age of the specimens. Examined under the ultra-violet rays, the genuine pieces were readily distinguished from those which were more modern than they purported to be. Among these sculptures was a Roman portrait head of the "Scipio" type which was immediately condemned. The little maiden by Dossena, a marble statuette in the archaistic Roman style, although its surface had been altered by baking the marble and then pitting it with a ragged stone, was shown by the test to have been made from recently cut marble. In addition, the three portions into which the sculpture had been broken were found to be part of the same piece of marble. This would dispel certain current rumors that one of the parts of the figure was old, and that the other two had been added only to repair the statue. An Attic female head of Pentelic marble, which is surely of the fourth century B.C., showed upon examination that a break at the back of the head was of recent date.

An examination of some Italian Gothic sculptures from a pulpit showed that those parts of the marble which were least exposed to the elements underwent the least change. Moreover, it was possible to distinguish between the fresh cuts on the back and the parts which had been covered by mortar. Among the Renaissance marbles studied under the ultra-violet light, a fifteenth-century portrait in relief showed a break which had been patched with a small piece of new marble and enamel paint. These restorations had been made so skilfully that they were not apparent to the naked eye. Among the eighteenth-century marbles, two busts by Houdon were compared and found to be almost identical in their fluorescence, although to the unaided eye one of them had a modern appearance due to over-cleaning of the surface at some time.

As with all new things whose possibilities have not been thoroughly probed, it may be supposed that the ultra-violet light will be a panacea for all troubles. But just as with the x-ray plate it requires a wide experience with varying cases, and no less careful judgment. Our experiments show that the ultra-violet rays will be of very great assistance in establishing the age of marble. That the ultra-violet rays have possibilities which are not limited to this field alone we are learning from our studies with other kinds of material.

[1] Fluorescence (or luminescence, if the substance retains fluorescence after it is exposed to the radiation of the ultra-violet light) is a property of certain substances which closely resembles phosphorescence, the difference existing in the duration of the effect after the exciting cause is removed.

[2] I am greatly indebted to other members of the Museum staff, for without their coöperation these experiments would have been impossible.

MR. HOEBER RELINQUISHES JOURNAL

With the present issue the contract expires between the American Roentgen Ray Society and Paul B. Hoeber, Inc. for the publication of the AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY.

It is with regret that the Society announces that this contract will not be renewed. Our membership is most appreciative of the splendid work accomplished for the Journal by Mr. Hoeber and his staff and is also appreciative of his many efforts in behalf of the Journal. Our very cordial thanks are given to Mr. Hoeber for his many courtesies and our good wishes are extended for the continued success of his publishing enterprises.

A. C. C.

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

UNITED STATES OF AMERICA

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. John T. Murphy, 421 Michigan St., Toledo, Ohio.
Thirty-first annual meeting: 1930, to be announced.

AMERICAN COLLEGE OF RADIOLOGY
Secretary, Dr. Albert Soiland, 1407 S. Hope St., Los Angeles, Calif.
Annual meeting, Detroit, Mich., 1930.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. G. W. Grier, Jenkins Arcade, Pittsburgh, Pa.
Annual meeting, Detroit, Mich., June 23–27, 1930.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. Walter T. Bronson, Northwestern Univ. Med. School, Chicago, Ill.
Fifteenth annual session: New Royal York Hotel, Toronto, Canada, Dec. 2–6, 1929.

RADIOLOGICAL SECTION, LOS ANGELES COUNTY MEDICAL SOCIETY
Secretary, Dr. Lowell S. Goin, Wilshire Medical Building, Los Angeles.
Meets on the third Wednesday of each month at the California Hospital.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
Secretary, Dr. W. S. Lawrence, Medical Arts Bldg., Memphis, Tenn.

BUFFALO RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St.
Meets second Monday of each month except during the summer months, the place of meeting to be selected by the host.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. W. T. Bronson, Englewood Hospital.
Meets monthly on second Thursday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. Harry L. Farmer, 2930 Prospect Ave.
Meetings are held at 6 o'clock at the University Club, on the fourth Monday evening of each month from September to April, inclusive.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. E. R. Witwer, Harper Hospital.
Meets monthly on second Friday from October to May, at Wayne County Medical Society Building.

CENTRAL ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. H. C. Kariher, Decatur, Illinois.
Regular meetings held quarterly.

INDIANA ROENTGEN SOCIETY
Secretary, Dr. J. N. Collins, Indianapolis, Ind.
Annual meeting each February 22 in Indianapolis.

MILWAUKEE ROENTGEN RAY SOCIETY
Secretary, Dr. J. E. Habbe, 221 Wisconsin Ave., Milwaukee.
Meets first Friday in October, December, February and April.
Place of meeting designated by the president.

NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. Thomas R. Healy, 370 Marlboro St., Boston, Mass.
Meets monthly on third Friday, Boston Medical Library.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. E. Everett Rowell, 200 West 59th St.
Meets monthly on third Monday, New York Academy of Medicine.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

PACIFIC COAST ROENTGEN RAY SOCIETY
Secretary, Dr. Harold B. Thompson, Seattle, Wash.
Two meetings a year.

PENNSYLVANIA RADIOLOGICAL SOCIETY
Secretary, Dr. W. E. Reiley, Clearfield, Penna.
Two meetings a year, April and October.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary Dr. John T. Farrell, Jr., 235 S. 15th St., Philadelphia.
Meets monthly on first Thursday evening, Pennsylvania Hospital.

ROCHESTER ROENTGEN RAY SOCIETY ROCHESTER, N. Y.
Secretary, Dr. James M. Flynn, 282 Alexander St.
Meets monthly on the first Friday evening at 7.45 at the Rochester Medical Association Building.

ST. LOUIS ROENTGEN CLUB
Secretary-Treasurer, Dr. L. R. Sante, Missouri Building.
Meets first week of each month. Time and place of meetings designated by president.

TEXAS RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. C. P. Harris, Houston, Texas.
Meets annually one day preceding the meeting of the Texas State Medical Association.

UNIVERSITY OF MICHIGAN ROENTGEN RAY SOCIETY
Secretary, Dr. D. M. Clark, University Hospital, Ann Arbor, Mich.
Meets every Wednesday evening from September to July, at 7:30 o'clock in the amphitheatre of the University Hospital.

VIRGINIA ROENTGEN RAY CLUB
Secretary, Dr. Wright Clarkson, 205 S. Sycamore St., Petersburg, Va.

BRITISH EMPIRE

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY
Director, Dr. John Muir, 32 Welbeck St., London W. 1.

* Secretaries of societies not here listed are requested to send the necessary information to the editor.

Meets on the third Thursday of each month, from November to June inclusive, at 8.15 P.M., at 32 Welbeck St., London, W. 1., or as advertised.

ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)

Meets on the third Friday of each month during the winter at 8. 30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

SECTION OF RADIOLOGY AND MEDICAL ELECTRICITY, AUSTRALASIAN MEDICAL CONGRESS

Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

Third session, Sydney, Sept. 2–7, 1929.

RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION

Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.

Meets monthly at Melbourne during the winter.

SECTION ON RADIOLOGY, CANADIAN MEDICAL ASSOCIATION

Secretary, Dr. A. H. Rolph, 160 St. George St., Toronto, Ont.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION

Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch.

Meets annually.

Continental Europe

BELGIAN SOCIETY OF ROENTGENOLOGY

Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).

Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

SOCIETE DE RADIOLOGIE MÉDICALE DE FRANCE

Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

SOCIETE FRANCAISE D'ELECTROTHÉRAPIE ET DE RADIOLOGIE MÉDICALE

Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHOSLOVAKIA

Secretary, Dr. Walter Altschul, German University, Prague, 11/52.

DEUTSCHE RÖNTGEN-GESELLSCHAFT (GE SELLSCHAFT FÜR RONTGENKUNDE UND STRAHLENFORSCHUNG)

Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.

Permanent secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.

SUD- UND WESTDEUTSCHE RÖNTGENGESELLSCHAFT

Meets annually in different cities.

NORD- UND OSTDEUTSCHE RÖNTGENGESELLSCHAFT

Meets annually in different cities.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY

Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

SOCIETA ITALIANA RADIOLOGIA MEDICA

Secretary, Professor M. Ponzio, University of Turin, Turin.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.

Secretaries, Drs. S. A. Reinberg and S. G. Simonson.

Meets annually.

Sixth Annual Meeting, 1929, to be announced.

LENINGRAD ROENTGEN RAY SOCIETY

Secretaries, Drs. S. G. Simonson and G. A. Gusterin.

Meets monthly on the first Monday at 8 o'clock in the State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY

Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.

Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

POLISH SOCIETY OF RADIOLOGY

Secretary, Dr. A. Elektorowicz, 19 Hoza St., Warsaw.

Meets annually.

WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY

Secretary, Dr. B. Krynski, 11 Zielna St.

Meets once a month except in the summertime.

SCANDINAVIAN ROENTGEN SOCIETIES

The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with the exception of the Denmark Society, meets every second month except in the summertime:

SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN

Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY

Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK

Secretary, Dr. O. Wissing, Copenhagen

Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

SOCIETY OF MEDICAL RADIOLOGY IN FINLAND

Meets in Helsingfors.

VIENNA SOCIETY OF ROENTGENOLOGY

Secretary, Professor Holzknecht, Vienna, IX, General Hospital.

Meets on the first Tuesday of each month from October to July.

VIENNA LETTER

(From Our Special Correspondent)

THE ACHIEVEMENTS OF THE ROENTGEN THERAPY OF PEPTIC ULCER OF THE JEJUNUM

Professor M. Haudek, Vienna, has experimented for a long time with roentgen rays in the treatment of gastric and duo-

denal ulcer, and as a result of his experience he states that it is unfortunate that roentgen radiation is often neglected as a therapeutic agent in this condition. Roentgen treatment is also efficacious in ulcer of the jejunum which is, however, a fairly infrequent occurrence since resection of the stomach has been more generally instituted. He admits that complete recovery is not the rule in every case but he has observed marked improvement associated with a gain in weight and this may be expected in practically every case where roentgen treatment has been used. The excruciating cramps and vomiting which occur at times in operated cases can be attributed to the spasm occurring at the anastomosis. The roentgen examination often reveals the congestion in the stump of the resection as shown by the narrow band of the abducting anastomosis loop, and the gastrospasm is often evident on the greater curvature side of the stomach in the vicinity of the anastomosis. It is on account of the spasm on the greater curvature that the abducting loop gets pinched off in such a manner that the escape of the food through the stoma is often retarded. Not infrequently, however, the roentgen finding is entirely negative. According to Blond, the so-called vicious circle and peptic jejunal ulcer are only different designations for equal occurrences. The vicious circle does not originate mechanically through the formation of a spur, but through a spastic incarceration of the vertex of the sutured loop into the stomach. The primary lesion is certainly the tendency of the stomach to segmentary spasm formation which is not always averted by resection. In some cases it is possible to prevent these spasms by the administration of papaverin. Roentgen treatment has a beneficial action which often prevents this segmentary spasm even after the first application of the rays. The technique consists of irradiating one field dorsally and one field ventrally; the field of irradiation is usually 20 by 15 cm. in the upper part of the epigastrium; 6 H through 3 mm. Al is given at three day intervals. It is perfectly safe to repeat the dose through the same fields after the lapse of four weeks; at the second treatment, however, one should give only 4 H through a 4 mm. Al filter. The strikingly favorable and spasmolytic action is attributed to the reëstablishment of the equilibrium of the autonomic nervous system. It is in this way also that the beneficial effects of roentgen therapy are explained when administered over the epigastric area following cholecystectomy.

A NEW PROTECTIVE DEVICE AGAINST ROENTGEN INJURIES OF THE EYE

Dr. E. Wölfling of Basel, Switzerland, some twelve years ago suggested the use of lead glass shields for the prevention of roentgen injuries to the eye. These shields at that time had to be placed over the cornea, not unlike an artificial eye. It developed, however, that this protection was not entirely satisfactory because the lead glass used is pervious to the roentgen rays at 50 kv. tension (only 50 per cent of the rays being absorbed), and it is not surprising that there occurred in the literature reports of many cases developing grave inflammations of the eye following the irradiation of palpebral tumors. Müller, an optician of Wiesbaden, who is a specialist in the manufacture of artificial eyes, recently brought out a shield made of lead glass which is much more impervious to the rays and is capable of absorbing 87 per cent of the rays administered. Wölfling experimented further with shields made of pure lead of 1, 1.8 and 4 mm. thickness. These shields are quite similar in form to the Müller glasses and their inner sides are gilded galvanoplastically. These shields, at a tension of 80 kv. are capable of absorbing 99 per cent of the roentgen rays when the application is made through 0.5 mm. Zn and 2 mm. Al filter, and thus from a practical point of view offer perfect protection. By this method of protection not only palpebral tumors may be irradiated but also the neoplasms of the iris, in which case a window has to be cut in the shield corresponding to the site of the tumor. Moreover the use of the lead plates is quite equal to that of the glass plate. It is advisable to smear the inner and outer surface of the shields with some kind of grease. These lead plates or shields are manufactured by the same firm,

namely, Müller, an optician in Wiesbaden, Germany.

THE ROENTGEN THERAPY OF RAYNAUD'S DISEASE

Dr. J. Borak, Vienna, tried mild irradiation over the regional segments of the spinal cord in 18 cases of Raynaud's gangrene and in every one of these cases succeeded in obtaining satisfactory results. The dose over each field amounted to ⅓ skin unit dose; that is, 200 R (4 H); distance 30 cm., filter of 0.5 cm. zinc, and about 170 kv. (focal dose 60 to 90 R). This dose is repeated after a lapse of six to eight weeks. Within one or two weeks following the first series, the painful cramps become much less frequent and the excoriations and ulcers begin to heal. After the termination of the second series the fingers and toes take on a purplish hue and the patient's fingers are not so cold and the previous chalky white fingers begin to show a little color, except the more distal parts which remain white. After a third series the intervals are prolonged to fourteen days. Borak's patients who have been irradiated withstood the extraordinarily severe winter of 1928–1929 without any trouble. The most beneficial results in the roentgen-ray treatment for the hands has been when the irradiation was administered over the lower cervical and upper dorsal segments with the first dorsal vertebra as a center of the field of irradiation. For the feet the segments of the lower dorsal and upper lumbar vertebrae were treated with the first lumbar vertebra as a center for the field of irradiation. These beneficial results following roentgen therapy over the respective spinal cord segments would cause one to conclude that Raynaud's disease is of central origin and is probably due to hyperexcitability of the sympathetic spinal cord centers.

THE KING OF SWEDEN'S GIFT OF SIX GRAMS OF RADIUM TO AID IN THE FIGHT AGAINST CANCER

On the occasion of the seventieth birthday of Gustav V, King of Sweden, the Swedish nation presented him with 5,000,000 Kroner. From this sum the King graciously gave 1,300,000 Kroner for the purchase of 6 grams of radium, while the rest of the sum he donated for the purpose of cancer research. These 6 grams of radium will be distributed among the Swedish scientific institutes under the control of the celebrated Swedish radiologist, Gösta Forssell. The radium consists of 9 gm. of radium sulphate which in radiation effect corresponds to 6 grams of pure radium. This is divided into 50 mg. particles which are put into separate containers which in turn are placed in cases lined with lead. The weight of these cases amounts to about one ton. This 6 grams pure radium represents such a mighty energy that even after the passing of 1700 years only half of the energy will have been wasted.

THE FIRST YEAR'S REPORT OF THE SWISS RADIUM FUND

The Zurich Radium Fund was established in 1927 at the initiation of the recently deceased Zurich roentgenologist, Dr. Bär. He was not only the founder but was one of the chief donors to the fund, opening the subscription list with a magnificent gift. This fund began work at once in 1927 but its first report has just been published. The report gives an account of the work during the past year and at the same time it details the working program for the coming years. It is a pity, says the report, that the radium stock of Switzerland is parcelled to about ten institutions in five cities. Zurich itself has 335 milligrams of radium, thanks to the generosity of its inhabitants. During the next year they will make every effort to raise this quantity to at least 500 mg. During 1927–1928 the available radium has been used by three clinics, the surgical, dermatological and laryngological, and by three private surgeons. Out of 158 patients treated with radium, 108 suffered from cancer, 31 from different types of tuberculous infection, while the rest of the cases had various ailments. Radium treatment was given in many cases which were quite inoperable. The results according to the report, in general were not the most favorable; however they seem to hold out considerable hope for the future.

THE ROENTGEN DIAGNOSIS OF POLYCYSTIC KIDNEY

At the recent meeting of the Budapest Roentgen Society, Dr. M. Jacob exhibited a large collection of pyelograms. He said that from the point of view of diagnosis one is able to distinguish five kinds of deformities in the pyelograms made during the course of the disease. In the first group he places those pyelograms which are made in the first stages of the disease when only a few cysts are shown in the cortical substance of the kidney. The roentgenograms in this stage reveal very little that is characteristic so that the diagnosis is very uncertain or impossible at this stage. In the second group are placed those cases in which the formation of the cysts is extensive throughout, but there remains considerable functional renal substance so that the functional test of the kidney and its results determine the diagnosis. It is characteristic of the pyelograms of the third stage that the thin elongated calyces dilate clublike towards the substance of the kidney and also that the renal pelvis becomes thinner, more elongated and the calyx system occupies a considerably larger surface than is shown in the normal conditions. The characteristic of the pyelograms of the fourth group is that the changes in the calyces are less pronounced, there being considerable diminution of the lumen of the calyces. Some of the remaining calyces become confluent with the cysts and display bulging dilatations. The fifth group embraces those cases in which there are shadows of calculi observed in the polycystic kidney. The roentgenograms of the second stage do not give rise to misinterpretations of diagnosis. In the third stage the pyelograms may simulate changes observed in tumors and only the elongated form of the renal pelvis calls attention to the possibility of the presence of a polycystic kidney. This finding should be of enough significance to cause one to make a pyelogram of the other kidney for comparison. Bilateral changes of a similar nature point to polycystic kidneys. It is most difficult to recognize the disease when stone shadows are visible in the polycystic kidney because the pyelogram resembles a hydronephrosis caused by the stone; it is in such cases that only the double sided pyelogram can make sure of the diagnosis. In the differential diagnosis of polycystic kidneys pyelography has been a tremendous aid in arriving at a proper diagnosis, especially if in every instance of inconclusive one-sided pyelogram we also do a pyelogram of the other side for comparison.

THE ESTABLISHMENT OF A PROFESSORSHIP OF ROENTGENOLOGY AT THE UNIVERSITY OF BUDAPEST

For a long time the University of Budapest has had a modern roentgen-ray laboratory where the clinics had access to roentgen-ray work of a high standard. The Minister of Public Instruction has recently created a new chair for the professorship of roentgenology and to this chair appointed Dr. Béla Kelen, a pioneer roentgen-ray worker in Hungary. Parallel with his roentgen studies, Dr. Kelen has made a special study of morbid pathology, internal medicine and gynecology. He has done a great amount of work in the field of roentgenology and has made special researches in the domain of the biological effect of roentgen rays, the different kinds of rays and has elaborated a special method for making plastic roentgenograms. He has also made a special study of protection against the harmful effect of roentgen rays.

DEPARTMENT OF TECHNIQUE

Department Editor: DAVID R. BOWEN, M.D., Pennsylvania Hospital, Philadelphia, Pa.

In this department will be published from time to time, as material is available, suggestions for improvement in technique.

HYSTEROSALPINGOGRAPHY*

DESCRIPTION OF SPECIAL PRESSURE APPARATUS AND TECHNIQUE

BY SAMUEL A. ROBINS, M.D.

Director, Roentgen Department, Beth Israel Hospital

BOSTON, MASSACHUSETTS

SINCE the introduction of pneumoperitoneum in this country by Stewart and Stein, in 1919, transuterine insufflation of the tubes by Rubin, and the work of Sicard, Forestier, Portret and others, the method of uterosalpingography has opened a new field in the study of gynecological conditions by the roentgen ray. Information, hitherto only gained by surgical exploration, has been gathered by this new technique. These methods made the preoperative diagnosis of lesions in the female pelvic organs so precise, and the technique so simple, that one should hesitate to resort to an exploratory laparotomy.

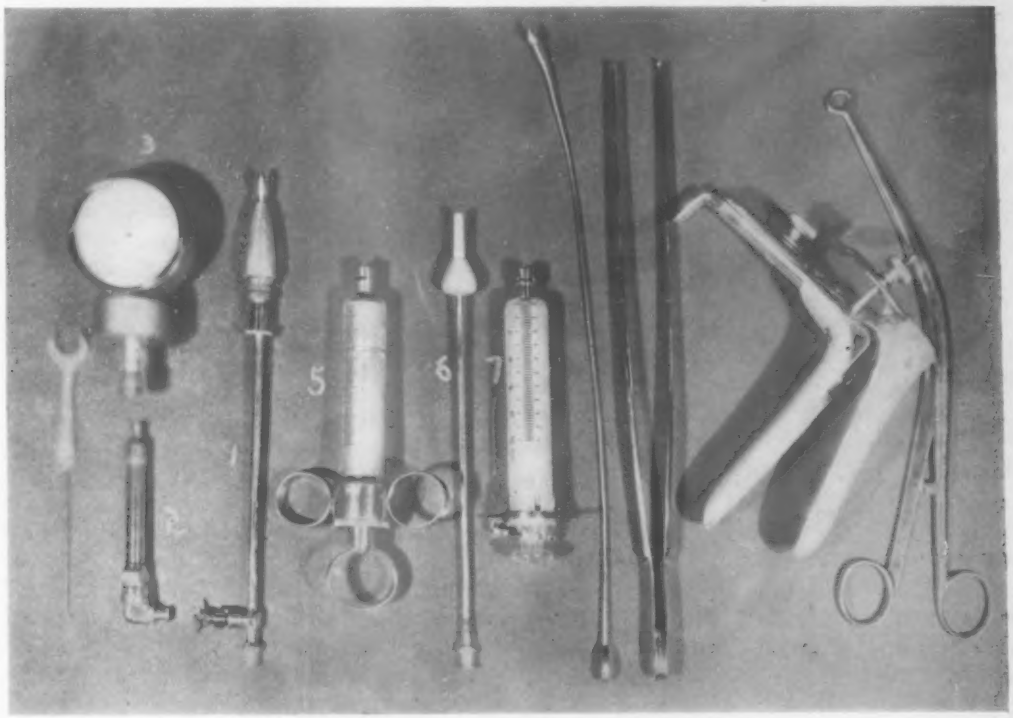

FIG. 1. Instruments used for hysterosalpingography.

It is only within the last few years that accounts of uterosalpingography appeared in the medical literature in this country. At first, it was advocated only in the study of sterility as an adjunct to the Rubin test, but now its scope has widened to such a degree that it may be used not only in sterility, but in routine examinations. In our experience, it is much easier, safer and more reliable than

* From the X-Ray Department, Beth Israel Hospital, Boston, Mass.

the use of gas. It has proved to be of inestimable value in the diagnosis of uterine growths, inflammation of the

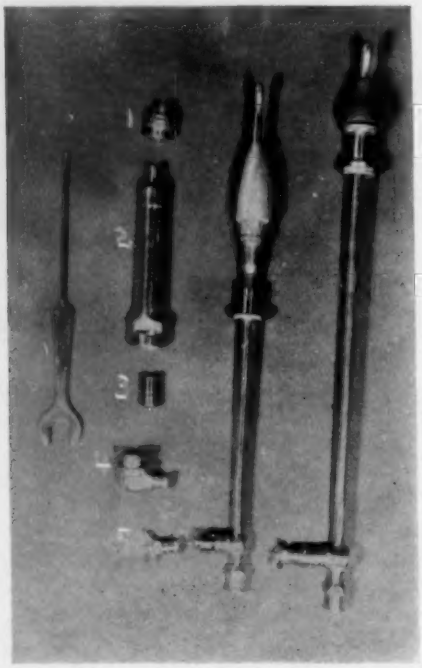

Fig. 2. 1. Connection for Tycos manometer. 2. Barrel. 3. Piston. 4. Connection for cannula. 5. Plug for cannula. 6. Cannula.

adnexa, adhesions, hydrosalpinx, malpositions, malformations of the uterus, spasm and extra-uterine pregnancy.

Heuser was the first to demonstrate its value as a diagnostic aid in very early pregnancy. In 1914 Cary used collargol to determine the patency of the fallopian tubes, and in 1915 Rubin employed a solution of 20 per cent sodium bromide. In 1921 Sicard and Forestier were the first to demonstrate the value of lipiodol as an opaque medium for exploration of the body cavities by the roentgen ray. In 1922 Portret first used lipiodol in the uterine cavity.

Hysterosalpingography is a simple and harmless office procedure, but it must be done carefully, under strict aseptic technique, and without pain to the patient.

In order to standardize our technique, and to guard against complications from too high pressure, we developed a simple apparatus, which has been used in over 200 cases with gratifying results. The apparatus consists of:

1. Two cannulas.
2. Pressure chamber.
3. Manometer.

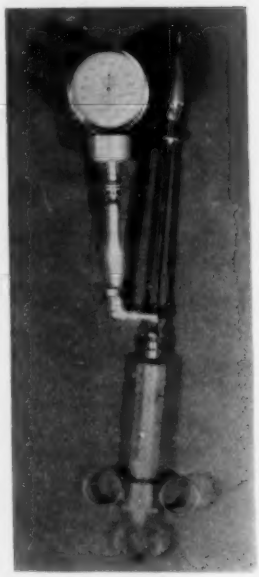

Fig. 3. Air chamber, manometer, syringe and cannula assembled.

4. Bivalve speculum.
5. Uterine probe.
6. Dressing forceps.
7. Two 10 c.c. syringes.
8. Rubber acorn tip.
9. Small wrench.

The cannula is 8¼ inches long, 3/16 inch in outside diameter, and has a 1/8 inch opening (inside diameter). The lower end is fitted with a connection for a Luer-Lok syringe and another connection at right angles for a plug and pressure chamber (Fig. 1).

There is an adjustable stop for the rubber tip that can be placed at any portion along the cannula, allowing for the introduction of the tip of the cannula into the cervix or into the uterus, as the case may indicate.

The other cannula is a simple tube with a stop for the rubber tip, described below under "Technique."

The pressure chamber has a valve to prevent oil from entering into the Tycos manometer, the lower end of which is fitted with an attachment to connect over the top of the pressure chamber (Figs. 2 and 3).

The blades of the bivalve speculum are made of aluminum to permit the rays to pass through in order not to obscure the outline of the cervical canal, so that its length and capacity may be studied, as well as the position and condition of the internal os. That this is of great value in the diagnosis of sterility can be easily demonstrated.

TECHNIQUE

The patient presents herself for examination about ten to twelve days before or after the menstrual period and is instructed to take a mild cathartic the night before examination. A preliminary examination, on a 14″ × 17″ film, of the entire abdomen is made to study the presence of masses or calcified glands. The bladder must be empty.

1. The perineum is washed with soap and water, then rinsed with a mild solution of corrosive sublimate.

2. The bivalve speculum is inserted and the vagina is wiped out dry with sterile gauze.

3. The entire vaginal canal and cervix are painted with 4 per cent mercurochrome or any other antiseptic.

4. The cervix is grasped with the tenaculum and the external os is swabbed with mercurochrome.

5. A uterine sound is used to determine the size of the uterine cavity, and also to displace any tenacious mucus.

6. A plain cannula is attached to a 10 c.c. Luer syringe and introduced into the cervix. Suction is applied to remove all secretions from the cervical canal and uterine cavity.

7. The second Luer syringe is filled with 8 to 10 c.c. of lipiodol and then attached to the second cannula. The lateral opening is closed with a special plug and the air is expelled from the cannula. The capacity of the cannula is 2 c.c.

8. Remove plug and attach air chamber The piston must be down and should be tested with the special wrench handle.

9. Attach manometer to pressure chamber.

10. Introduce cannula into cervix and slowly inject the iodized oil.

11. A stereoscopic examination is made with two 10″ × 12″ films, with the ordinary Bucky diaphragm technique, holding the cannula in position while the exposure is made (Fig. 4).

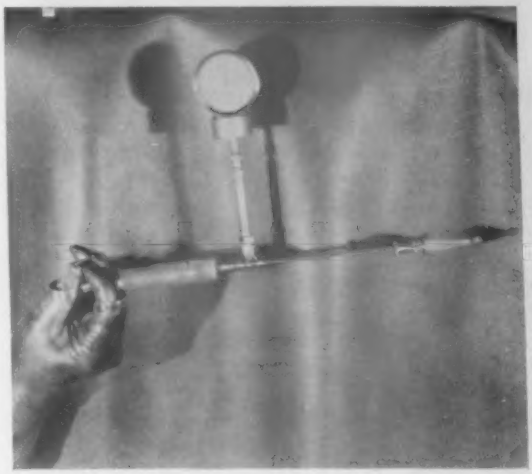

Fig. 4. Apparatus ready for use.

12. The cannula is then removed and the oil is thoroughly wiped out of the vagina. The instruments are removed and a strip of sterile gauze is placed in the vagina to absorb the excess iodized oil returning from the uterus.

13. One hour later the gauze is removed and a roentgenogram is made on a 10″ × 12″ film.

14. The patient returns for a final examination forty-eight hours later.

The entire examination should take from fifteen to twenty minutes. We never use a pressure higher than 220 mm. Hg. Very interesting pressure curves were obtained.

Care must be taken to clean the pressure chamber. Gasoline or carbon tetrachloride may be used to dissolve the oil. The plunger must always move freely in the barrel to register accurately.

CONCLUSION

The apparatus which is described for performing hysterosalpingography is easily assembled and sterilized, and is simple to handle.

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

Bonaccorsi, A. The digestive organs in splenomegaly. *Radiol. med.*, Sept., 1929, xvi, 857–874.

A systematic study of the digestive tract in cases of enlarged spleen has shown that there are serious changes in the position, form and function of the digestive organs and the author believes that this mechanical factor of the topography of the abdominal organs explains the pathogenesis of many abdominal symptoms seen in enlarged spleen from malaria. It is true that the plasmodia cause infarcts of the capillaries, embolism and thrombosis, but he believes that the localization of the parasites in certain abdominal organs is determined by the mechanical changes brought about by the enlarged spleen.

The most constant changes in the stomach in enlarged spleen are lateral dislocation to the left of the whole stomach from the cardia to the duodenum, slight anterior rotation of the body of the stomach and a lacunar defect in the greater curvature from the pressure of the spleen on it. In the duodenum there is marked displacement to the right, defective emptying of the bulb and pain on pressure. In the intestine there is displacement of the jejunum and ileum to the right, retardation in emptying of the ileum, lowering of the splenic flexure of the colon and a depression in the right colon caused by the spleen, the concavity being upward and toward the side. There are other changes which are less constant but still frequent, such as signs of atony of the stomach associated with slight ptosis and dilatation with retardation in emptying of the stomach and weak peristalsis and signs of inflammatory colitis, particularly in the ascending colon, cecum and splenic flexure.

Burke, Garry R. Hereditary deforming chondrodysplasia (multiple cartilaginous exostoses). *J. Bone & Joint Surg.*, July, 1929, xi, 570–578.

Burke reports 3 cases of hereditary deforming chondrodysplasia occurring in one family. The mother had died at the age of thirty-five following an operation for a recurrent tumor of the left shoulder which had been diagnosed as malignant osteochondroma of the scapula, with involvement of the acromion process and the outer end of the clavicle. The father was examined and no evidence of exostoses was found.

Since the inheritance is usually immediate, from parent to offspring, and no cases of transmission through an unaffected male are recorded, Burke assumes that these 3 cases inherited the disease from their mother. He thinks the malignant osteochondroma from which the mother died might very well have had its origin in an exostosis. Ehrenfried states that the most frequent and most serious complication of hereditary deforming chondrodysplasia is the development of a rapidly growing or malignant osteocartilaginous tumor in one of the exostoses, estimating that this complication has occurred in about 5 per cent of the reported cases. The change may develop between the ages of eleven and fifty-nine, but it usually occurs soon after skeletal growth has ceased—that is, between twenty-five and thirty-five years. Only one of the three patients complained of any symptoms, and in this case it is doubtful if the shooting precordial pain of which complaint was made was really referable to the tumor.—*R. S. Bromer.*

Castronovo, E. Roentgen pictures of subacute and chronic ileocecal invagination. *Radiol. med.*, Sept., 1929, xvi, 917–954.

The author reviews some cases which he has previously published and adds some new ones which are freely illustrated with roentgenograms. He tries to give a complete roentgen picture of subacute and chronic ileocecal invagination He begins by reviewing the pathologico-anatomical facts necessary to an understanding of the pictures and then describes the technique used. The examination may be made by means of the roentgen meal, enema or insufflation or the three methods may be used together except for some contraindications which are reviewed. If the examination is made by means of enema he emphasizes the necessity for roentgenoscopic control during the irrigation and of making examinations from time to time after evacuation of a part of the liquid. The roentgen signs are both direct and indirect. The indirect signs are the general signs of stenosis of the intestine, the absence of gas at the hepatic angle of the colon, displacement of the stomach and duodenum, the way in which the loops of small intestine are arranged with a tendency to occupy the position of the

invaginated part of the colon, and the position of the terminal loop of the ileum. There is a difference in the direct signs depending on whether the examination is made by means of an opaque meal or by enema. Under the former the author describes the stenosis of the ileum with a characteristic bird-beak form, the absence of the ileocecal portion and the opaque band where the invaginated and invaginating parts are superimposed. He describes the movements which accompany the formation of the band and suggests some technical points which are an aid in demonstrating it. He then shows that a retrograde impregnation of the cavity not filled by the meal may be obtained by the antiperistaltic movement of the colon on giving a barium enema; this cavity is impregnated directly through perforations in the intussusceptum which puts the internal and external cavities into communication, bringing about what he calls a short circuit in the fecal circulation. He describes a clinical case which shows this possibility.

With reference to the effects obtained by enema the author considers two types of invagination: those with a penetrable and those with an impenetrable sheath. By the sheath he means not only the invaginating part but also the external mucous cavity, that is the space around the intussuscepted part. It is possible for the invaginations caused by tumor to be of the first type and it would be very interesting clinically to determine whether this is always true. In the form with a penetrable sheath the author describes a series of pictures, which he describes as the fork, the hook, the onion, the rosette and the opaque mantle and there may also be pictures with large lacunae and total impregnation of the sheath. This difference in the pictures is caused by varying tonus of the intussusceptum; there are hypertonic and hypotonic forms.

The author discusses the characteristic fashion in which the invagination behaves during the irrigation and during its evacuation. The enema causes profound changes in the tonus of the intussuscipiens which have the effect of elongating it first and then shortening it, which moves the invagination upward during the irrigation and downward during its evacuation; the movement upward may appear to be a partial reduction of the invagination. He then describes the characteristic spiroid pictures which may be obtained by impregnation of the sheath, their different degrees and the mechanism of their formation. The author thinks such pictures will be of the greatest value to the surgeon as showing him just where to operate and avoiding unnecessary exploration.

Chizzola, G. Roentgen study of diseases of the muscles. *Radiol. med.*, Sept., 1929, xvi, 899–913.

The author discusses the roentgen signs of disease of the muscles, taking up particularly the diseases of muscle which are shown by direct roentgen signs, such for example as Virchow's ossifying disease of muscle or Münchmeyer's disease, the calcifying forms of myositis or myopathy, Krause's progressive interstitial calcinosis and some localizations of parasites in the muscles. The changes which these diseases may cause in the roentgen picture are many and varied; they are sometimes characteristic and sometimes atypical but it is certainly important for the roentgenologist to know them. The author makes a personal contribution to this chapter in roentgen diagnosis by describing 3 cases of his own. The first one was a case of Virchow's progressive ossifying disease or Münchmeyer's disease in a girl eight years of age with multiple diffuse ossifications which were general and symmetrical in distribution and involved the muscles of the trunk chiefly. The others were cases of calcifying myopathy in men of fifty-three and fifty-two years of age respectively. The first of them had a chronic osteoarthropathy of the coxofemoral joint and quite an extensive process of calcification in the muscles of the pelvis; the second patient, who had had a severe trauma of the pelvis, showed long opaque stripes in the gluteal region on the right side, due probably to calcification of muscle bundles in the gluteus maximus.

Craig, Winchell McK. The use and abuse of iodized oil in the diagnosis of lesions of the spinal cord. *Surg., Gynec. & Obst.*, July, 1929, xlix, 17–28.

The test of any procedure is its application over an extended period in the hands of many experienced practitioners. A review of the literature shows that lipiodol is not an innocuous ingredient which is to be used in all cases of suspected compression of the spinal cord, but that it has its use and abuse. Its greatest use is demonstrating the presence of a suspected tumor. Its greatest abuse is in cases that have not had a thorough neurological examination.

Sicard and La Plane called attention to an irritative reaction of the meninges following the injection of lipiodol, which varies in severity. Belado and Franke stated that the reaction is manifested by a definite pleocytosis and that the cells called into phagocytic action are polynuclears and mononuclear leucocytes. Sicard and Forestier stated that this reaction of 100 to 200 cells to the cubic millimeter disappeared on the seventh day. Ebaugh and

Mella found evidence of asceptic meningitis which subsided in three days. The systemic effect consisted in pain down both legs, elevation of temperature, nausea and headache. Lindblom in his experimental studies carried out on rabbits found that it gave rise to acute leptomeningitis which subsided in two to three weeks. Wolfsohn and Morrissey found an inflammation in two tumors. Sharpe and Peterson had to perform a laminectomy to relieve an encysted globule of lipiodol because of severe symptoms. Hiller found evidence of marked inflammatory reaction adhesions, and a cystic formation at operation in a case. Mackeddie called attention to the inflammatory reaction in abnormal nerve tissue. Mixter and Ayer state that lipiodol remains as a foreign body. They emphasized the absence of a subarachnoid block as a contraindication of its use. Armour noted meningeal reaction at operation following the use of lipiodol. He stated that patients with lesions of the cauda equina had increased difficulty in micturition. Armour summarized the use of lipiodol as follows: (1) It should not usurp the place of repeated clinical examinations. (2) It should only be used after a subarachnoid block has been demonstrated. (3) It should not be employed unless the possible danger of complications is out-weighed by the more exact localization likely to be obtained. (4) Finally, in properly selected cases, lipiodol is a definite aid in the study of compression of the cord which if used intelligently will increase the possibility of successful removal of tumors of the spinal cord. They can be detected and removed at an earlier stage, thereby the percentage of cures is increased and the operative mortality is reduced.

At the Mayo Clinic, lipiodol radiologique descendant, N.N.R., was injected into the cisterna cerebellomedullaris (cisterna magna) with the patient in a prone position. The patient was roentgenoscoped and the roentgenoscopic table was tilted gradually and the lipiodol was observed to descend and roentgenograms were made after an interval of twelve and twenty-four hours, a second and a third series of roentgenograms were made. Ten cases are reported.

Case I. There was no block in the subarachnoid system. Tumor localized and removed.

Case II. Tumor localized and removed.

Case III. Intramedullary cyst diagnosed and drained. The roentgenogram showed the typical cap described by Mixter.

Case IV. Illustrates the division of the lipiodol in some types of spinal cord lesions.

Case V. An inflammatory lesion which did not obstruct the lipiodol.

Case VI. Inflammatory reaction following the use of lipiodol.

Case VII. Bilateral sciatica in which the symptoms were exaggerated for several months.

Case VIII. Long funnel-shaped shadow usually seen in inflammatory lesions. Inflammatory process made acute by lipiodol.

Case IX. Inflammatory reaction set up in tumor by lipiodol. Patient died. Cause unknown.

Case X. Tumor localized unnecessarily with lipiodol.—*E. P. Pendergrass.*

EISENDRATH, DANIEL N., and ARENS, ROBERT A. Pyelography and cholecystography as aids in the differentiation of shadows due to renal or biliary calculi. *Surg., Gynec. & Obst.*, July, 1929, xlix, 1–16.

The authors quote the differential diagnosis as outlined by Cole, Nichols, Young and Waters and Braasch and Hager, which their experience leads them to believe are of little value.

Is the location of a shadow of any assistance? The authors show numerous examples why the location alone of a given shadow is of little help in differentiation of a biliary from a renal calculus.

Can one place any reliance in such a differentiation upon the number, the density, the form, or change in position of the shadows? One may find multiple renal calculi. The density of a shadow is generally thought to be due to the atomic weight, the structure and its thickness. The authors show numerous examples demonstrating that one cannot depend upon the density entirely for differential diagnosis. The branching renal calculus and the typical small faceted gallstone does not offer any difficulty in diagnosis. However the large oval shadow in right cholecystorenal region offers much difficulty and it is here that the cholecystogram and the pyelogram are invaluable.

Renal and biliary calculi have a wide range of mobility. Of how much value are cholecystography or a combination of both?

The value of cholecystography is in detecting the presence or absence of biliary calculi in 95 per cent of cases according to Case. If one cannot differentiate shadows in the right upper quadrant, with roentgenograms made in various positions, the authors suggest *doing cholecystography first.* This is ample in most cases where the dye is sufficiently concentrated. Second, ureteropyelography alone. This is usually all that is necessary to prove or exclude the presence of renal or ureteral calculi. Third,

cholecystography and pyelography combined are recommended in the following cases: (a) if cholecystography fails to yield a gall-bladder shadow, pyelography will be invaluable; (b) if there is any doubt concerning the intrarenal character of the shadow in spite of its extrabiliary relation to a cholecystogram; (c) if the shadows are extrabiliary and extra-renal such as calcified retroperitoneal glands, common duct stones, pancreatic calculi and pigmented moles—*E. P. Pendergrass.*

Frejka, Bedrich. Heterotopic ossification and myositis ossificans progressiva. *J. Bone & Joint Surg.*, Jan., 1929, xi, 157–166.

Frejka reports a case of myositis ossificans progressiva, well illustrated with roentgenograms. In the cases published hitherto, four following types may be distinguished: The first occurs chiefly in early childhood, usually associated with microdactylia of the toes, particularly of the large toes. Authors assume in this type a congenital anomaly of mesenchyma, and the slow and gradual onset is characteristic of this type. The second includes the cases which develop from rheumatic inflammation with arthritic changes in the joints. The third includes those cases connected with trauma, in which ossification followed each severe trauma, in one case even trauma by palpation. The fourth is myositis ossificans neurotica, observed after transverse lesions of the spinal cord.

Frejka's résumé follows: "A case of myositis ossificans progressiva developed in a patient with arthritic predisposition and with a congenital microdactylia of both great toes. The malady began as an attack of acute rheumatism, and led to entire ankylosis of the spine and formation of extensive bony layers which embraced the thorax, connecting it by bony bridges to both humeri. After the disappearance of the last acute symptom, the conditions of the patient remained unchanged.

"The X-ray picture showed diminished hypophyseal fossa. In cases reported by different authors, the disease sometimes has developed without any visible causes, such as after infectious diseases,—cold, influenza, tonsillitis, etc.; or after traumata; or after transverse lesions of the spinal cord. These cases cannot be considered as different affections, but as the same malady, the same dystrophic constitution, in which different factors will produce the same changes. The nature of the dystrophy is still obscure,—possibly an altered metabolism, caused by disorders of endocrine glands.

"The mode of new bone formation is explained by Leriche's theory. Two conditions are necessary: (1) Embryonic tissue formation, which may be due to organization of hematomas or to inflammatory process in the tissue. All granulous tissue may be also regarded as embryonic tissue. (2) Embryonic tissue not infrequently appears during the life of an organism, but the ossification may occur only if the second condition,—viz., the increased amount of lime salts in regional tissue lymph—is present.

"The bone is not formed thus by osteoblasts,—these preformed cellular elements endowed with specific property of ossification—but, on the contrary, they are only modified connective tissue cells, which may appear secondarily in any situation, where, on the base of the connective tissue, a new bone may develop. It may be stated therefore, that the new bone may develop anywhere in an organism, even in regions distant from the skeleton."—*R. S. Bromer.*

Jordan, Sara M., and Kiefer, Everett D. The irritable colon. *J. Am. M. Ass.*, Aug. 24, 1929, xciii, 592–595.

"Irritable colon" has been used to define a condition in which the musculoneural apparatus of the colon has lost its coordination and correlated function. The coordinated motion of the parts of the colon through rhythmic and synchronized contraction and dilatation is lost because of a disturbance in the tonus and irritability of the musculoneural tissue, with the result of delayed or increased motility, excessive, or subnormal absorption of fluid, and imperfect digestion of cellulose. Of 3000 colons examined at the Lahey Clinic, 30 per cent of these were found to have no other lesion except this colonic musculoneural disturbance. Generalized abdominal tenderness was frequently found with this condition. Other symptoms were such as epigastric distress, generalized abdominal distress, abdominal distention, loss of appetite and left upper quadrant pain, most frequent being that of gaseous eructations. Some cases gave a history of epigastric distress which was typical of ulcer distress. The disordered colonic function was evidenced by abnormal stools or the use of catharsis. The roentgenologic diagnostic criteria are: (1) length of colon; (2) the rate at which the colon fills and empties; (3) the appearance, depth and frequency of haustral markings; (4) the diameter of the colon under a certain head of pressure, and (5) the absence of sensation or the occurrence of distress to the patient during the passage of the enema. A low cecum and a high hepatic or splenic flexure and a high straight sigmoid may result in loss of tone in stretching of

colonic muscle. Spastic contractions of the colon interfere with the filling and the emptying of the colon. The depth of haustral markings in a normal colon is about ¼ the diameter of the colon. The diameter of the normal colon varies, being slightly narrower in the descending and sigmoid portion and slightly wider in the cecum. The normally irritable colon when filled with barium gives an urge for defecation, there being no colicky distress. Absence of this sensation indicates hypo-irritability.

The article contains six illustrations. Figure 1 shows normal colons in youth and old age with regularly placed haustra ¼ of an inch in depth. Figure 2 shows four types of irritable colons, the first shows hypotonus and hyperirritability, the second hypertonus and hyperirritability, and the other two show mixed tonus types. Figure 3 shows megalocolon with same colon at three intervals after institution of treatment. Figure 4 is that of a colon in an old man, which was dilated and produced epigastric distress, and also shows colon after treatment. The last two figures are in a woman of eighteen and a child of ten showing results of bowel management to overcome hypotonus of colon which was producing symptoms.

In the summary it is pointed out that the patients frequently complain of digestive symptoms. The symptoms may be suggestive of various organic lesions. The use of the roentgen ray with the barium enema is a good way to follow progress of treatment of cases of hypotonus of the colon.—*E. P. Pendergrass.*

MAY, R. V., THOBURN, T. W., and ROSENBERGER, H. C. Aspiration during tonsillectomy; a roentgenologic study. *J. Am. M. Ass.*, Aug. 24, 1929, xciii, 589–592.

Richardson first described the pulmonary aspects of tonsillectomy under inhalation anesthesia in 1912. There are two schools of thought concerning it, one believing in the embolic theory and one insisting that the aspiration theory is the only tenable one. The author by statistics demonstrates that pulmonary abscess may follow any surgical procedure. In reading the literature he felt that bronchoscopy and laryngoscopy in determining the amount of material aspirated during tonsillectomy was unsatisfactory and that roentgen study of the chest would give more information. He decided to render the secretions of the throat opaque to roentgen rays, and then roentgenograms of the chest during and following operation would demonstrate the presence or absence of aspirated secretions and their distribution through the tracheobronchial tree.

The author in this study used as clinical material 25 patients operated on for removal of tonsils and adenoids. Age incidence was three to twelve years. The patients had a preoperative physical examination. After operation the patients were discharged from the hospital the same evening following a throat examination. The anesthetic was nitrous oxide induction followed by straight ether and then ether and nitrous oxide. The first 11 patients were given anesthetic deep enough to keep them quiet and the following 14 had a light anesthetic which resulted in straining and coughing. The first 11 were inclined head down at an angle of 20° during operation and the next 14 were inclined 45°.

As soon as possible after the anesthetic was started the first roentgenogram was taken before the operating table was tilted. After the table was tilted and the mouth gag was in place 2 or 3 cc. of equal parts of olive oil and iodized oil thoroughly mixed and warmed were instilled. Precautions were taken to keep the oil from entering the larynx during its introduction. An attempt was made to direct the iodized oil to the nasopharynx. Following this all accessible secretions and oil in the pharynx were sponged out and a second roentgenogram was made. The left tonsil was removed. All secretions were carefully removed from the pharynx. Again 2 or 3 cc. of iodized oil were instilled and after removal of the secretions and oil from the pharynx another roentgenogram was taken. The same procedure was repeated after removal of the right tonsil. The adenoids were removed and a fifth roentgenogram was made. In 8 cases a sixth film was taken on the discharge of the patient.

The author includes a table describing his results. In his comment on the results he states that since the excess oil instilled was quickly swabbed out the aspiration of excess secretions was negligible. In 2 cases suction was used to test its merits and iodized oil was found in the tracheobronchial tree in both cases. Several cases showed that aspiration may occur and yet after operation there may be no remaining evidence.

The results of this work showed: (1) Aspiration occurred in 6 cases of the first 11 and in 6 cases of the following 14. The percentage of the whole series was 48. (2) Marked aspiration occurred in both cases in which suction was used. (3) In 4 cases the aspirated material was in the upper right chest. In 6 cases it was in both lungs and in 2 it was demonstrated as far as the trachea. (4) Of 5 cases showing aspirated material after operation, 4 showed almost complete elimination at the end of six hours.

In his conclusions the author points to the superiority of roentgen study in this work over bronchoscopy and laryngoscopy. He states that aspiration may be decreased by extreme Trendelenburg position, constant removal of pharyngeal secretions, and the choice of anesthetic and operative technique and also the degree of anesthesia which should at least in part preserve the laryngeal and tracheal reflexes.

The frequency of aspirated material in the right upper chest will warrant more investigation. Most of the aspirated material is eliminated at the end of six hours.—*E. P. Pendergrass.*

MILCH, HENRY, and POMERANZ, MAURICE. Bone changes in Gaucher's splenomegaly. *Ann. Surg.*, April, 1929, lxxxix, 552–560.

In the words of the authors, "Gaucher's disease has been defined as a constitutional disturbance of the albumin, fat and iron metabolism which expresses itself in specific changes in the reticulum cells of the lymphatic-haemopoietic system." First described by Gaucher in 1882, only 50 authentic cases are on record. The bone marrow changes, while recognized, have received little attention. Two cases reported emphasizing the clinical and roentgenological evidence of the involvement of the osseous system.

Cases may occur in which symptoms referable to the osseous system may precede or overshadow the enlargement of the spleen and liver. In such cases the diagnosis may be "rheumatism" or tuberculosis, as in the cases reported.

The roentgenologic changes in the bones characteristic of Gaucher's disease are medullary absorption, cortical thinning, and expansion of the bone and cystic absorption in the joint surfaces. The medullary absorption gives a mottled appearance to the bone and is probably due to localized proliferation of Gaucher cells. The cortical thinning and expansion of the bone probably result from increased subcortical pressure exerted by the growing masses of cells. This pressure is probably also responsible for the bone pain and tenderness. Either pressure or direct invasion of the articulating cartilages by the Gaucher cells is the probable cause of the cystic appearance in the joint surfaces of the bones. Periosteal changes are usually slight.

The bone changes in Gaucher's disease make it necessary that the condition be differentiated from tuberculosis, lues, leucemia, and so-called "rheumatism." These changes are usually so characteristic that this differentiation is usually possible.—*E. P. Pendergrass.*

MOFFAT, BARCLAY W. Köhler's disease of the patella. *J. Bone & Joint Surg.*, July, 1929, xi, 579–581.

Moffat reports a case of isolated disease in the patella showing changes similar to those described by Köhler as occurring in the tarsal scaphoid. In Köhler's original paper describing the condition found in the tarsal scaphoid, he noted an abnormality of the patellae in one of the three cases reported. Since the publication of his paper there have been many cases of the scaphoid condition reported, but few of the patellar variety.

In Moffat's case the patella showed on roentgen examination, fragmentation and some disintegretation. To prevent further separation of the fragments the child was operated upon for the insertion of a purse-string suture about the patella. At operation a section of bone was removed for study. Histological examination showed no evidence of osteitis. The bone was everywhere invaded by cartilage. The appearance corresponded to that described in microscopic examination of sections of the femoral head affected by Legg's disease.

Moffat calls attention to the following points of interest in this case. (1) The association of a chronic inflammatory process as a possible etiologic factor; (2) the absence of any evidence that the bone condition itself was inflammatory in character, and (3) the elongation of the bone which was probably in adaptation to the axial strain to which it was subjected in its softened condition.

This condition is apparently what is termed an epiphysitis—for want of a better name—by which is understood a disturbance in the normal development of a bone, occurring at the age when it is in process of ossification. If the condition occurring in the tarsal scaphoid is of similar pathology, the roentgen appearance here differs, because the bone is subjected to compression rather than axial traction.—*R. S. Bromer.*

MOUCHET, ALBERT. Metatarsal epiphysitis. *J. Bone & Joint Surg.*, Jan., 1929, xi, 87–93.

Mouchet reviews the literature of Köhler's disease of the second metatarsal, or as it is also frequently called the second Köhler's disease. Freiberg first described it in 1914, publishing 6 cases of this metatarsal lesion, under the title of "Infraction of the Second Metatarsal Bone." Moutier of Nantes, in his important article published in 1925, proposed the more simple term "metatarsal epiphysitis." He collected 100 published cases. Mouchet found 120 or more.

The location of the disease, its clinical course, the character of the disease process, and its

treatment are thoroughly discussed. No illustrations of roentgenograms are given. Mouchet emphasizes the necessity of roentgen examinations, not only as the only means of absolutely confirming the diagnosis, but also as the only possible way to observe the progress of healing. For the latter purpose roentgen examinations should be made every three or four months. In the initial period of the epiphysitis, the treatment should be conservative. Rest and immobilization of the foot in plaster are advised, allowing walking on crutches. At the end of six months, if the osseous repair is sufficient, immobilizing apparatus may be discarded, and moderate use of the foot allowed. The result of the roentgen examination should be the guide. For cases, first seen in the advanced period of the epiphysitis, in the stage of arthritis deformans, resection of the metatarsophalangeal joint is advised.—*R. S. Bromer.*

MUZII, MARIO. Two cases of "free duodenum." *Radiol. med.*, Sept., 1929, xvi, 913–917.

Most of the cases of common mesentery published in the literature are ones of total inversion of the position of the small and large intestine; there are very few cases of free duodenum. The author therefore describes 2 cases in women aged forty-seven and twenty-five. The roentgen picture was very clear in both cases, particularly so in the second one in which it was taken at a time in the process of digestion when the abnormally placed duodenum was clearly visible throughout, together with the small intestine which was rotated entirely into the right half of the abdomen. Both of these patients up to adult life had had perfect intestinal function and the symptoms which brought them for examination were rather indefinite ones of disturbances of the colon. They had alternating constipation and diarrhea and vague abdominal pain which disappeared in the first case and improved greatly in the second on medical and dietetic treatment for colitis. So there may be considerable anomalies in the position of the digestive tract without any special symptoms; they may not be noticed until late in life and then only on roentgen examination made for some other purpose.

NICOTRA, A. Calcification of the pulpy center of the intervertebral discs (infectious intervertebral chondroneuritis). *Radiol. med.*, Oct., 1929, xvi, 977–993.

Three cases are reported in which there was calcification of the center of the intervertebral discs and a fourth in which the calcification was incomplete. The structure of the gelatinous nucleus helps to explain this process of calcification following infection. It is soft and made up of tracts of connective tissue in which there are groups of cells of varying size; they are clear and transparent and have one or more nuclei and are residues of the embryonic chorda dorsalis. These cells are more numerous in young people and decrease or disappear in old age. This gelatinous center swells easily on exposure to air, protrudes above the surface when the disc is cut and in water may swell to three times its original volume. This embryonic gelatinous substance first swells and then calcium salts are precipitated in it. The author thinks that in the majority of cases the disease stops in the stage of opaque swelling without causing permanent solid calcification. The relation of the roentgen pictures to the clinical neurological syndrome is discussed. The symptoms are those of irritation of the spinal nerve roots and meninges. He thinks this is an independent disease the cardinal symptoms of which are calcification of the gelatinous center of the discs and the reaction of the meninges and nerve roots. He thinks that many forms of radiculitis are due to this disease, even when the roentgen picture does not yet show calcification of the pulpy nucleus of the intervertebral discs; this may become manifest later during the period of stabilization or it may not occur at all in mild cases in which there is only swelling of the gelatinous substance without calcification. The disease is an inflammation which almost always begins acutely with fever, possibly at a period long before the roentgen picture shows the characteristic change, and in all probability it is a localization of influenza virus in the intervertebral disc. The author thinks a careful search should be made for a history of fever even when the patient does not report it at first. In the third of his cases he found that the patient had had an influenza years before and a careful investigation showed that the nerve-root symptoms had begun about this time.

As the author feels quite sure that this is a localization of influenza in the intervertebral discs he gives it the name of infectious chondroneuritis and he thinks that many forms of radiculitis that have not been studied sufficiently may be classified under it.

NILSONNE, HARALD. A case of congenital talipes calcaneovalgus with a strange development of the astragalus. *J. Bone & Joint Surg.*, Jan., 1919, xi, 60–64.

Nilsonne reports a case which presented the clinical picture of an ordinary congenital talipes calcaneovalgus, but which on roentgen

examination revealed very peculiar changes, particularly of the astragalus.

A roentgenogram made at the age of nineteen months showed the astragalus strangely changed. Its middle part showed ordinary bone structure and shape, but the head and the posterior process revealed small patches of uneven bone structure with lighter lines and areas alternating with patches obviously denser, the latter being of greater density than the rest of the bones of the foot. The posterior process appeared to be enlarged in a mushroom-like fashion.

The deformity of the foot was corrected by manipulations under anesthesia and the patient was discharged with the foot corrected. He was readmitted to the clinic five years later because of marked recurrence of the foot deformity.

A roentgenogram made after the second admission to the clinic showed an astragalus that in relation to the calcaneus seemed to be somewhat larger than normal. It was smallest in its middle part, while the head as well as the posterior process was enlarged in a slightly mushroom fashion. In the posterior part, the bone structure was slightly mottled; the same appearance, though more marked, was observed in the anterior part. The outline in front was flattened out in a clearly bowl-like fashion and with a silghtly nodular roughness. At the anterior upper corner of the scaphoid there was a rounded shadow, the size of a pea.

The histological examination showed an exceedingly peculiar cartilaginous tissue. There seemed to be no question, however, of any chondromatous change. In the cartilage there appeared a great aggregation of big endoplasm "balls," most numerous and large as the ossification zone was approached, which was arranged in very disorderly fashion. No necrosis nor signs of present or past inflammatory process could be found.

Nilsonne thinks that these changes might have a certain connection with juvenile growth disturbances, such as Köhler's disease in the scaphoid and that of Legg-Perthes-Calvé-Waldenström in the head of the femur. The fragmentation and the partly denser bone structure are points in common. The skeletal affection, however, in his case, was observed at an age when these common growth disturbances are unknown and, furthermore, the histological appearance does not tally. It seems that entirely unknown changes in the skeleton took place in this case, at least Nilsonne could find no trace of anything like it in the literature. The histological examination does not point to any tumorous tissue or to any necrosis or inflammatory process. Ossification is not inhibited, only disarranged. The aggregation of endoplasm balls is a strange feature. Whether there is a question here of cartilage remaining from an embryonic stage, or a disturbance in the growth simulating a fiberless embryonic cartilage, can scarcely be ascertained; yet Nilsonne thinks that one might venture to suggest that it is a question of embryonal tissue elements partly fixed in bone tissue.—*R. S. Bromer.*

Ochsner, Alton. An unappreciated cause of chronic bronchitis. *J. Am. M. Ass.*, July 20, 1929, xciii, 188–190.

Chronic bronchitis is one of the most frequent conditions treated by the general practitioner and its treatment is often unsuccessful. While many of the author's cases were in elderly persons, a good percentage were in university students. The finding of a marked degree of bronchiectasis by bronchography in a patient giving no symptoms of early bronchiectasis suggested the possibility of finding many among others who had suffered recurrent attacks of acute bronchitis. A large series of patients were thus examined and 90 per cent were found to have bronchial dilatation. It is evident that the most important indication for bronchography is chronic cough or chronic bronchitis. The author found repeated introduction of iodized oil into the tracheobronchial tree to be of therapeutic value. The cough and sputum are decreased and the fetid odor of the sputum is lessened. Eventually it is possible to obtain a symptomatic cure. The author maintains that if bronchography is to be done in early cases it must be simple. He discusses five methods of the introduction of iodized oil into the tracheobronchial tree and concludes that they are all too complicated and too unpleasant for the patient.

In contrast to these more complicated procedures the author describes his "passive" technique. He states that there are two phases to the act of swallowing; voluntary and involuntary. He inhibits the latter by producing a sensory anesthesia of the anterior tonsillary pillars, which is the source of the involuntary phase in the act of swallowing, and thereby inhibits the reflex action of the pharyngeal muscles to produce this action, the anterior pillars being painted with 10 per cent cocaine solution. This is repeated until the swallowing reflex is abolished as evidenced by immobility of the larynx on attempted deglutition; then 3 cc. of a 3 per cent solution of procaine hydrochloride solution which acts as an anesthetic to the tracheobronchial mucosa. Following this the anterior pillars are again painted with 10 per cent cocaine

solution. Now the patient is placed behind the roentgenoscopic screen and instructed to aspirate 10 cc. of iodized oil. The author states that it is necessary to remember that the anesthetic is only temporary and secondly, that the introduction of the oil should be watched. He states that he has used this roentgenoscopic method in 1500 instances without bad results. In his conclusion he reiterates the above points: (1) that of finding bronchial dilatation in 90 per cent of the cases with chronic bronchitis; (2) that bronchography should be used in all cases of chronic bronchitis lasting over a period of months; (3) that iodized oil is of a definite therapeutic value, and (4) that introduction of iodized oil into the tracheobroncheal tree should be as simple as possible.—*E. P. Pendergrass.*

RATTI, A. Roentgen picture of tumors of the ribs. *Radiol. med.*, Oct., 1929, xvi, 1027–1037.

Primary malignant tumor of the ribs is quite rare. Tumors of the ribs are more frequently metastatic and in the majority of cases follow tumors of the breast. The author describes a case of primary tumor of the ribs which proved on histological examination to be osteosarcoma. The roentgen picture showed an ovoid tumor at the sternal end of the sixth right rib. It was the shape and size of a small egg and its opacity was uniform and not very dense. If it had not been for the contrast of the lung fields the tumor itself could not have been seen, but only the rarefaction of the part of the rib between the tumor and the normal bone. On the whole, the picture was not very different from that of tuberculosis at this site and the picture of a case of tuberculosis is given for comparison. The chief difference is at the boundary between the normal and pathological bone. In the case of tuberculosis the boundary zone shows a small tract of greater opacity, which is the characteristic picture of the productive reaction often seen in bone tuberculosis. In the case of tumor, on the contrary, at the boundary zone the tumor tends to invade the rib, which appears to be less calcified than normal and shows islands of rarefaction.

A number of cases of metastatic tumors of the ribs are described and illustrated. They show two different types; in one there is a single metastatic nodule with total destruction of the part of the rib affected and in the other diffuse infiltration of the bone. Five of the cases were of the first type and the tumors were epithelial in nature; two were of the second type and the tumors were mixed connective tissue tumors. Nodular metastatic tumors in cancer of the breast are generally on the posterior part of the rib.

VALLEBONA, A. Roentgen registration of the movements of the heart. *Radiol. med.*, Oct., 1929, xvi, 1004–1016.

The author reviews the different methods that have been used for registering the movements of the heart muscle and finds that even the most perfect of them, such as cinematography, are hard to apply practically. He then describes a technique that has given him satisfactory results. He takes several roentgenograms in a second on the same film, moving the film a half centimeter to one side for each roentgenogram. In this way a number of outlines of the heart are obtained, each one representing a different phase of its activity and each one independent of all others. There is an apparatus with a crank which at each half-turn closes the circuit of the primary current and an arrangement for moving the film the desired distance during the interval. There is a special frame on which the film is carried in front of the body of the patient. By superimposing the different outlines on each other a picture is produced from which an idea can be obtained of the activity of the different segments of the heart in systole and diastole.

REID, ADA CHREE. The value of the fluoroscope as an adjunct to routine physical examination of the chest. *Am. Rev. Tuberc.*, July, 1929, xx, 46–51.

In the years 1924 to 1927, 53 cases of tuberculosis were admitted to a sanatorium for tuberculosis eighteen months after they began to work for the Metropolitan Life Insurance Company. Presumably they had tuberculosis at the time of their employment despite a negative physical examination at that time. It is admitted by a number of competent observers that physical examinations may miss early tuberculosis in 5 to 10 per cent of individuals. Cavities may be missed in as high as 50 per cent of the cases. It would be costly to make roentgenograms of everyone employed, but it is not particularly expensive to have them roentgenoscoped. It is felt that the roentgenoscope is a valuable adjunct to physical diagnosis and has been employed in the home office of the Metropolitan Life Insurance Company since October 1, 1927. From October 1, 1927 to September 30, 1928, 4883 applicants were passed on physical examination, 59, or 1.21 per cent, were found by roentgenoscopic examination to have tuberculosis. This was confirmed by roentgenograms. Of the 59 cases, 25 reported back in one year. Sixteen were found to have active progressive tuberculosis. The lesions demonstrated varied from minimal to well-advanced lesions.—*E. P. Pendergrass.*

SATTA, F. Coxa protrusa. *Radiol. med.*, Oct., 1929, xvi, 993–1004.

Protrusion of the acetabulum into the pelvis results from an acute or subacute infection of the hip which may be primary or secondary, particularly following typhoid, gonorrhea or septicemia from pus cocci. It is the true or idiopathic form of this unusual change in the joint; it is an inflammatory malacia and must not be confused with the false form of protrusion which is caused by a deforming osteoarthrosis, by tabes, neoplasm, trauma, generalized bone dystrophy, etc. The author thinks that probably when the symptomatology of this protrusion, which he calls coxa protrusa, is better known it may become established as a special and independent deformity, as coxa vara is now. Tuberculosis of the hip does not bring about a true protrusion of the acetabulum. Caries of the acetabulum, even when it is extensive and causes perforation and destruction of the acetabulum, is followed by a stage of reparation which sometimes gives a picture that may be mistaken for that of protrusion of the acetabulum. The author describes 3 typical cases of coxa protrusa, the first of which followed a puerperal septicemia with phlebitis of the leg; the second probably followed a gonorrheal arthritis of the hip and the third a subacute septic infection after a delivery that was apparently normal.

SOSSI, OSCAR. Some possibilities of error in the roentgen diagnosis of disease of the apices. *Radiol. med.*, Sept., 1929, xvi, 892–898.

Tuberculosis of the apices may be shown in the roentgenogram either by a uniform veiling of varying degrees of intensity or by nodules of shadow. It is sometimes hard to determine whether an apical picture is due to disease of the pleura or the lung. As a general rule nodular shadows indicate disease of the lung while a uniform veiling is more apt to be caused by disease of the pleura. But there are some causes outside of disease of either the pleura or apices that may cause such a picture. The middle part of the apex may be veiled by the shadow of the sternocleidomastoid; there may also be veiling of the apical region from asymmetrical development of the musculature, from increase of subcutaneous tissue or from certain pathological changes in the skin, or more rarely from abnormal development of the thyroid, aneurysm of the arch of the aorta or local injections of iodide or mercury. There may be veiling of the apices from a wrong position of the patient so that one scapula comes farther forward than the other, but this can generally be detected by a careful study of the roentgenogram which shows that the spinous processes of the vertebrae are not exactly in the middle of the picture but somewhat to one side. In other cases the veiling may be due to atelectasis of the alveoli. A stenosis of the bronchi which aerate the apices may cause an opacity which it is hard to differentiate from that due to disease of the apices themselves; and the same thing may be said of atelectasis remaining after the resolution of pneumonia of the upper lobe. A slight atelectasis which is not manifest clinically may also cause one apex to be smaller than the other and veiled and it may also cause veiling indirectly by bringing about atelectasis of the lungs. And there are a few cases in which the apex field is darkened by a cervical rib. So great care must be exercised in making a diagnosis of disease of the apex from simple veiling.

Spots or nodules of shadow are more reliable but even here there are sources of error. The costal cartilages are not visible normally but may become so if calcium salts are deposited in them. In that case they may simulate opacities of the apex but the differentiation can generally be made from the fact that the shadows are directly continuous with that of the first rib. The most frequent and serious cause of error is infiltration or calcification of the supraclavicular glands. A number of roentgenograms are given of cases in which such glands simulated shadows due to tuberculosis of the apex.

STEIN, IRVING F., and ARENS, ROBERT A. A new radiographic table; with a description of the authors' complete equipment for pelvic radiography with iodized oil and pneumoperitoneum. *Am. J. Obst. & Gynec.*, July, 1929, xciii, 130-136.

The authors are convinced that the Peterson position (partial knee-chest posture) is the ideal position for making roentgenograms to obtain the maximum amount of information. Because of this they have developed a table on which is placed a Bucky diaphragm that will conveniently give them this.

In investigating pathological conditions of the pelvis the authors use a combined pneumoperitoneum (transabdominal or transuterine) and lipiodol. The former is used to demonstrate the organs, the latter to demonstrate the cavities of the uterus and tubes. They have developed a self-retaining catheter for the uterus.—*E. P. Pendergrass.*

WHEELER, DIGBY. The radiological examination of the heart and great vessels. *Canad. M. Ass. J.*, Aug., 1929, xxi, 189–195.

The author quotes Sir James McKenzie's statement that "the inspection and the palpa-

tion of the movements of the heart and the percussion of the heart's dulness give a far more valuable indication of the size of the different chambers of the heart than an X-ray examination. Indeed I am doubtful if any X-ray examination of the heart has ever thrown the slightest light upon any cardiac condition." Wheeler believes, on the contrary, that a roentgen examination offers confirmatory evidence in the study of the alteration in the size of one or more chambers of the heart, the position of the heart within the chest, the movements of the heart, fluid or gas in the pericardial sac, and calcification, aneurysm, or dilatation of the thoracic aorta. The roentgen examination is the only procedure which can accurately demonstrate the form and the size of the heart, the enlargement and pulsation of each chamber separately, calcification of the pericardium or thoracic aorta, small aneurysms and dilatation of the thoracic aorta. Roentgenologic examination should be supplementary to clinical examination.

Wheeler hardened a normal heart in situ, removed it from the thorax and placed it in the various anatomical positions used in the usual roentgen examinations. Illustrations of the photographs made of these positions are shown, with descriptions of the chambers of the heart, etc., which are responsible for the silhouette outline in any particular position. A normal heart was also injected, each chamber being filled with opaque barium sulphate solution and roentgenograms of this heart were made in all the usual positions. Each chamber could be thus definitely identified by the photographs and the roentgenograms. Illustrations of roentgenograms of pathological conditions are also included.—*R. S. Bromer.*

WILLIS, THEODORE A. The slipping femoral epiphysis. *J. Bone & Joint Surg.*, Oct., 1929, xi, 779–787.

Willis adds 15 cases to the number of recorded cases of slipping femoral epiphysis, and presents 3 in detail to illustrate his idea of the proper treatment of the lesion in its different stages. His paper is profusely illustrated with roentgenograms of the 3 cases and case histories are given in detail.

The greatest divergence of opinion is expressed by both European and American writers in regard to the etiology of the condition. This has become, Willis states, a triangular debate between the proponents of disease—particularly endocrine disturbance,—static forces, and trauma as etiological factors. He thinks the arguments on each side are convincing but until further proof is offered, none is conclusive. It is probable that any one of the three may predominate in an individual case, or be the sole factor concerned. The majority of his cases have occurred following definite injury in overweight adolescents of infantile type.

His conclusions with special reference to treatment are as follows: (1) No matter how treated, the lesion causes a premature fusion of the epiphysis and consequent effect upon growth; (2) there is deformity of the femoral head and acetabulum inversely proportionate to the efficiency of treatment; (3) there is restriction of function in proportion to the deformity, and (4) untreated or inefficiently treated cases show a typical deformity of thickened neck, coxa vara, limitation of lateral mobility and rotation, flattening of the acetabulum and femoral head, torsion and shortening of the femoral neck.—*R. S. Bromer.*

ROENTGEN AND RADIUM THERAPY

BARDACHZI, F., and EPSTEIN, R. Dosage and hardness of rays in malignant tumors. *Strablentberapie*, 1929, xxxiii, 139–141.

The authors think that intense irradiation with very hard rays is recommended too much as a matter of routine in the literature. There are two classes of tumors, in the first of which intense irradiation is indicated. These are localized tumors of such a size and nature that no general injury is to be expected from the irradiation, in which homogeneous irradiation is not difficult because of their site, in which there are no visible metastases and the patients are in good general condition. But unfortunately the second group in which intense irradiation is not only useless but dangerous is much larger. These are cases in which the tumors are no longer strictly circumscribed, are large, metastases are demonstrable or probable and the general condition is not so good. If tumors of this group are deep the authors at first give ¼ to ½ an erythema dose; after that they only give small doses of $\frac{1}{20}$ to $\frac{1}{10}$ of an erythema dose at intervals of two to three weeks. These doses of course can be continued for a long time. As a rule in such cases they use the large distant field method with hard, highly filtered rays. But if such tumors are more superficial they at first use a softer mixture of rays of about 100–150 kv. with 3 mm. aluminum filtration; they begin with ½ a skin erythema dose and continue with small or medium sized doses at intervals which depend on the reaction.

And even in some tumors of the first group which are superficial, such as metastatic

nodules after carcinoma of the breast, malignant goiters that are not too deep and lymph gland tumors, instead of the hard rays usually recommended as soft rays as possible should be used. This method is particularly to be recommended when homogeneous irradiation with hard rays is difficult or impossible for technical reasons or because of possible injury; it also has the advantage that such irradiations can be repeated at short intervals.

In lymphosarcoma hard rays are still often recommended in spite of the fact that these tumors are known to be very sensitive to rays and there is danger of general intoxication and formation of metastases after large doses. The authors recommend beginning with not more than a tenth of an erythema dose of very soft rays and not irradiating the tumor directly at first.

Beretvas, L. Roentgen depilation. *Arch. di radiol.*, Mar.-Apr., 1921, v, 425–444.

From a review of the literature and his own cases in a dermatosyphilitic clinic the author concludes that soft rays filtered through 1 mm. aluminum should be used in tinea and he insists on the importance of mechanical removal of the broken stumps of hair after the irradiation. The same kind of rays are used for depilation of the beard but in fractional doses and in association with antistaphylococcus vaccine. Hypertrichosis has been cured with rays filtered through 2 mm. aluminum but the results in this condition are not brilliant.

Borak, J. Roentgen therapy of symptoms of the climacteric. *Strahlentherapie*, 1929, xxxiii, 142–146.

Werner in 1923 first reported good results in symptoms of the climacteric from weak irradiation of the hypophysis. It was later found that the effect was improved by irradiating the thyroid also and that irradiation of the thyroid was sometimes effective in cases in which irradiation of the hypophysis alone failed. Holzknecht explained the results as being due to the fact that when the function of the ovary begins to decline there is an excessive function on the part of some of the cells of the hypophysis and of the thyroid which is overcome by the action of the rays.

The work of a number of authors is reviewed which shows that irradiation of the hypophysis alone is effective in about 75 per cent of the cases and when thyroid irradiation is also given the treatment is successful in about 85 per cent of the cases. The author irradiated 274 cases, from the end of 1923 to the end of 1928; 246 of these are still under observation and some of them have been under observation for years. His results agree very well with the averages from the literature. He had good results from irradiation of the hypophysis alone in about 80 per cent of his cases. The effect of irradiation of the hypophysis was improved in about 15 per cent of the cases by that of the thyroid and in another 10 per cent the results were not satisfactory until the thyroid was irradiated. In 63 per cent of the cases the good effect lasted for longer than six months and up to two to four years, while in 27 per cent it lasted less than six months. The roentgen rays alleviate and shorten the course of a natural process. The treatment may be classified as weak irradiation since the focal dose per series of irradiations is not more than 150–200 r, so there is absolutely no danger either to the skin or irradiated organs. If other treatments are not effective in a few weeks the author advises beginning roentgen treatment.

Casati, A. Some new indications for roentgen therapy based on the results of the Vienna school. *Arch. di radiol.*, Jan.-Feb., 1929, v, 178–201.

The results of the Holzknecht school are discussed. In surgery they have had excellent results in the treatment of inflammations. Statistics of 2000 cases show that in 25 per cent the process could be aborted in a few hours, in 50 per cent it was considerably shortened and in the other 25 per cent there was improvement. The focus always reacts more or less intensely to the rays, unless it is in a closed cavity such as the middle ear, the maxillary sinus, etc. The technique is very simple. Small doses of 1–2 h are given over the focus with not very hard rays (120 kv. max.) with a filter of 4 mm. aluminum. The irradiation may be repeated after four to eight days. Normally one to three irradiations are enough for good results, but some cases have to be followed up and irradiations given every two days. Recently Sgalitzer has had good results in acute exacerbations of chronic osteomyelitis.

Roentgen treatment has also given good results in gastric and duodenal ulcer. The good results generally begin in a few days after a single series of irradiations but there may be recurrence, in which case the treatment may be repeated. Small doses of 6 h are given in two doses with an interval of two days between, with rays of medium penetration (120 kv. max.) with a filter of 0.3 to 0.5 mm. zinc, alternately through an anterior and posterior field over the stomach. Postoperative pain from poor function of a gastroenterostomy opening may also be treated in the same way.

Other diseases that have been treated successfully are metastatic bone tumors, fibrous ostitis, brain tumor, habitual headache treated by irradiation of the hypophysis, acroparesthesia, intermittent claudication, various dermatoses and a number of gynecological conditions. Good results are obtained in the climacteric by irradiating the hypophysis and the thyroid; good results are also obtained in amenorrhea and dysmenorrhea by irradiating the hypophysis. Hemorrhages, not only gynecological ones but also extragenital ones, such as hemorrhage from ulcer and tumor have been favorably affected by irradiating the liver and spleen. Juvenile metrorrhagia that does not yield to irradiation of the ovary is often benefited by irradiation of the spleen. The spleen and liver are irradiated through an anterior field over each organ, giving 4 H with hard rays (170 kv. max.) with a filter of 4 mm. aluminum, repeating the series after a week. The effects are ordinarily manifest in two weeks. The series may be repeated after four weeks if necessary.

COPEMAN, S. MONCKTON; COKE, FRANK; and GOULDESBROUGH, CLAUDE. "Activated" (irradiated) fluorescein in the treatment of cancer. *Brit. M. J.*, Aug. 10, 1929, ii, 233–236.

The authors report the results on a series of 70 cases treated for cancer by a method consisting of painting fluorescein on the lesion followed by irradiation of the painted area. For the most part, fluorescein was used in the form of the soluble sodium salt. They are also testing the efficiency of salts of higher molecular weight, namely, potassium and strontium. The chemical characteristics of fluorescein are fully described. Control cases painted with fluorescein but which received no irradiation or activation showed no effect upon the lesions. It was found that an exposure, which will turn a three-quarter Sabouraud pastille (placed on the skin), all the rays having passed through a 4 mm. filter, was sufficient to accomplish results.

In conclusion, they direct attention to the following points: (*a*) Cases which respond most satisfactorily to treatment are those in which other methods of treatment have not been employed. If the patient has been already subjected to courses of roentgen rays or radium, this fact will probably militate against obtaining useful results with fluorescein.

(*b*) The more cellular and rapidly growing (that is, the more malignant) the growth, the more readily is it likely to respond to treatment.

(*c*) When fluorescein is given internally, in the course of treatment of cases of cancer of the breast, enlarged glands in the axilla have been found to disappear though not themselves directly activated.

(*d*) In the case of superficial secondary growths, such as recurrent nodules on or near the scar of an operation wound, excellent results have been obtained by the injection with a hypodermic needle of a few drops of fluorescein solution into the substance of the nodule prior to irradiation. Treated in this way, secondary nodules even of considerable size may disappear with unexpected rapidity.

(*e*) Cases previously regarded as inoperable, after a course of treatment with activated fluorescein have, in certain instances, been found at a comparatively early stage, to undergo such changes as to render them amenable to surgical intervention with satisfactory results.—*R. S. Bromer.*

CRAMER, H., and FECHNER, G. Clinical experience with intense red light irradiation. *Strablentberapie*, 1929, xxxiii, 186–195.

The authors report the results of intense red light irradiation in chronic and subacute polyarthritis, chronic and acute otitis media, chronic appendicitis, postoperative abdominal adhesions, chronic and subacute adnexitis, chronic prostatitis, myalgia, neuralgia and burns and freezing. In most cases after one to four irradiations at a distance of 15 to 30 cm. for five to ten minutes there was more or less pain which passed off after an hour or two. After four to eight irradiations or in some cases not until after twelve to fifteen the subjective symptoms disappeared completely. Blood counts made daily or every other day in 35 cases in the majority of the cases showed a marked increase of lymphocytes with more or less pronounced monocytosis and eosinophilia.

Eight of the most striking cases are reported and blood curves given. The authors conclude that red light is very effective and the blood picture is a good objective evidence of the results. In the majority of cases it shows a lymphocytosis though a lack of lymphocytosis does not necessarily mean that there is no clinical effect. This treatment should not replace roentgen therapy but supplement it. In neuralgias they would recommend using the more harmless red light method first and only using roentgen treatment when it fails. But in chronic arthritis after the effects of roentgen therapy were exhausted they have had excellent results from red light treatment.

Döderlein, A. Results of irradiation of cancer of the uterus. *Strablentherapie*, 1929, xxxiii, 89–90.

The results are given only in the form of tables showing the percentages of cures. The detailed report is made in *Arch. f. Gynäk.*, Vol. 136, No. 2. A study of the world literature on cancer of the cervix shows 1158 absolute cures out of 6827 cases treated by irradiation, or 16.9 per cent; out of 5806 cases treated by surgery there were 1111 absolute cures after the same period of five years, or 19.1 per cent. Out of 960 cases treated by irradiation there were 335 relative cures, or 34.9 per cent, and out of 3659 cases treated surgically there were 1303 relative cures, or 35.6 per cent. The corresponding figures for carcinoma of the body of the uterus were: absolute cures after five years by irradiation 32.7 per cent, by operation 42.8 per cent; relative cures by irradiation 51.9 per cent, by operation 62.5 per cent. The figures for absolute cures after five to fifteen years on irradiation of cancer of the cervix at the Munich University Gynecological Clinic 1913–1923 in Group I were 50.2 per cent, while the corresponding figures from the world literature for operation were 35.6 per cent. In Group II the figures for irradiation at the Munich Clinic were 28.3 per cent absolute cures, while the figures from the world literature for operation were 37.0 per cent; for Group III the Munich figures were 10.7 per cent; for Group IV they were 15.4 per cent, while in the world literature for surgical treatment they were 19.1 per cent. The average of absolute cures for the four groups on irradiation at Munich was 18.2 per cent while the figures from the world literature for surgery are 19.1 per cent. For carcinoma of the body of the uterus the figures at Munich for cure by irradiation were 40.9 per cent, while for surgery from the world literature they were 42.8 per cent; among the operable cases at Munich the cures were 66.0 per cent and among the inoperable cases 7.9 per cent. The five to fifteen year cures of Forssell, Regaud and Wintz are given. For carcinoma of the cervix they are 23.3 per cent for Forssell, 46.2 per cent of the operable cases and 13.9 per cent of the inoperable ones; for Regaud 16.6 per cent cures; among operable cases 25.8 per cent and among inoperable ones 10.0 per cent; for Wintz 18.9 per cent cures; among operable cases 57.4 per cent, among inoperable ones 12.3 per cent. The figures for carcinoma of the body of the uterus are for Forssell 43.5 per cent cures, among operable cases 60.0 per cent; for Wintz 34.6 per cent cures; among operable cases 66.6 per cent.

Goldmann, R. The roentgen treatment of acute otitis media. *Strablentherapie*, 1929, xxxiii, 152–155.

It has generally been held that inflammations in cavitites with rigid walls cannot be treated successfully by roentgen rays but this is not true of the middle ear with its normal connection through the Eustachian tube with the nose and pharynx and pathological communication with the outside air through perforation or paracentesis of the tympanic membrane. The degree of the action, other things being equal, depends on the intensity and age of the inflammation. Thielemann was afraid from his experiments on mice that the ear would be injured by irradiation but the author has not found this true in his clinical cases. Irradiation is given over the mastoid and adjacent region. The author prefers a rather hard irradiation of about 150 kv. with filtration through 0.3 to 0.5 mm. zinc and 1 mm. aluminum. He uses 10–20 per cent of an erythema dose, depending on the intensity of the inflammation; this may be increased in torpid cases and decreased in ones with a violent course. The effect of the rays is sometimes shown by a temporary increase in the symptoms but within six hours there is decrease of the pain and fever. It reaches its height in the course of the next twenty-four hours and passes off in three to eight days. There is a striking increase in the discharge if there is one or if there is not it begins promptly even in cases in which paracentesis has been ineffective. In many cases a single irradiation is enough; if repetition is necessary in subacute and torpid cases, it is best to give it after the effects of the first irradiation have passed off, that is, in about three to eight days. Roentgen rays are more prompt and painless in their action than the usual remedies, including heat.

Groover, T. A., Christie, A. C., Merritt, E. A., Coe, F. O., and McPeak, E. M. Roentgen irradiation in the treatment of hyperthyroidism: A statistical evaluation based on 305 cases. *J. Am. M. Ass.*, May 25, 1929, xcii, 1730–1734.

From 1917 to 1927, inclusive, 477 cases were referred for roentgen treatment of hyperthyroidism. These have been subdivided into six groups.

Group I (38 cases) was made up mainly of adolescent and simple colloid goiters which at the time of observation did not show evidence of toxicity. The persistent normal basal metabolic rate was the important factor in determining their advice to refrain from roentgen therapy in this group.

Group 2 (11 cases) was a group wherein the advice for roentgen therapy was not heeded.

Group 3 (24 cases) was a group in which roentgen therapy was instituted but in which the diagnosis was doubtful.

Group 4 (34 cases) was a group in which there were insufficient data for statistical purposes.

Group 5 (65 cases) was a group in which roentgen therapy was instituted but abandoned before sufficient irradiation had been given to determine whether or not it would be efficacious. This is not surprising in view of the popularity of surgery among the medical profession and laity. Of the 65 patients in Group 5 who abandoned treatment, 24 received one, 22 received two, and 19 received three treatments.

In Group 6 there were 305 cases. All of these cases were studied thoroughly and treated long enough to allow judgment as to the efficacy of roentgen therapy. One hundred and forty-two cases had exopthalmos; 163 did not. No effort was made to further classify these cases. Of the 305 cases 37 were classified as mild, 157 moderate and 111 severe. This classification was based on the correlation of the clinical signs, symptoms and basal metabolic rate. The average age of the group was thirty-seven years and the average duration of symptoms was two and one-sixth years. In the series there were 26 cases in which a thyroidectomy had been previously performed. The cases were observed from 1 to 11 years.

RESULTS OF TREATMENT

	Number	Per Cent
Cured of hyperthyroidism	271	88.85
Improved	26	8.52
Unimproved	8	2.63
	305	100.00

By a cure was meant the disappearance of the signs and symptoms of thyroid intoxication with restoration of a normal basal metabolism. The most reliable sign of improvement was the weight curve.

In this group the average time of treatment was less than five months and the average time before improvement began was approximately two months.

RECURRENCES

After remaining well 5 years	1
After remaining well 4 years	1
After remaining well 2 years	1
After remaining well 1 year	1

In the group of 34 cases recorded as failures of roentgen therapy (26 improved and 8 unimproved), the authors carefully analyze all of the factors.

Hypothyroidism occurred in 4 cases and telangiectasis occurred in 6 cases.—*E. P. Pendergrass.*

HOLFELDER, H. How much is to be expected of roentgen treatment in so-called inoperable tumors? *Strablentherapie*, 1929, xxxiii, 131–138.

There are some kinds of tumors in which radium rays are beyond doubt superior to roentgen rays, as for instance carcinomas of the mouth, particularly the tongue, and carcinomas of the rectum. There is another group of tumors in which a combination of roentgen and radium therapy gives good results, including carcinoma of the larynx and the upper and middle esophagus. In almost all other surgical tumors the author thinks roentgen rays give at least as good results as radium and the treatment is much cheaper.

Holfelder has previously reported the good results of exclusive roentgen treatment in bone sarcoma and other forms of sarcoma; he has had good results in melanosarcoma, in some cases with exclusive roentgen treatment, in some with combined roentgen and radium treatment. He is now preparing statistical material on his results in different kinds of sarcoma and carcinoma. And in recent years he has had strikingly good results in a number of cases of inoperable stomach carcinoma. In scirrhous carcinoma of the stomach he has had only temporary improvements of a few months' duration. The prospects are much better in the medullary form of carcinoma of the stomach and in malignant degeneration of stomach ulcer if there are no metastases in the liver. It does not make much difference whether the tumor is on the greater or lesser curvature, at the cardia or pylorus, and metastases in the glands of the lesser omentum do not affect the prognosis particularly. He has now had a number of cases of carcinoma of the stomach free of signs of recurrence for more than two years after irradiation, two of which are described. Histological examination in one of them definitely proved carcinomatous ulcer, while the clinical picture in the other was so definite that there is really no doubt that it was carcinoma. He therefore thinks roentgen treatment is indicated in inoperable carcinoma of the stomach.

LACASSAGNE, A. Results of irradiation in adeno-epitheliomas of the uterus. *Strablentherapie*, 1929, xxxiii, 91–96.

This is a report of the treatment of 30 cases of adeno-epithelioma of the body of the uterus at the Paris Radium Institute from 1919 to 1927. Three of the patients had infectious

complications during or shortly after the treatment and died of them; in 12 cases the cancer continued to develop without any appreciable effect from the treatment; in 7 cases there was recurrence after varying periods of improvement; 3 of the patients died of dissemination of the cancer; 5 of them are living at present without any signs of cancer and are apparently clinically cured. This gives 16 per cent cures, which is much less than the figure for cures in epithelioma of the cervix (29 per cent) with approximately the same conditions of treatment and the same observation time. For the operable cases the percentage of cures (2 out of 13 cases) is particularly discouraging, as the cures in operable epitheliomas of the cervix in Stage I and II are 42 per cent. And even the cases classified as cured are questionable. In the only one in which cure was as long as five years ago the patient was operated on in 1920 for carcinoma of the body of the uterus; after that a small nodule appeared near the vulva that was probably an implantation carcinoma; this local lesion disappeared and has not recurred after interstitial radium treatment; a large dose was given by radium puncture. In one case the diagnosis of carcinoma was uncertain. And in the other 3 cases of apparent cure by combined intrauterine and external radium treatment the cures have only persisted for a year and a half. And with these very moderate results there was a large number of cases of death from infection and distant metastases and in a number the treatment apparently had no effect at all. In 18 of the cases only internal radium treatment was given; in 4 only roentgen irradiation was given; in 2 the intrauterine radium treatment was combined with roentgen treatment and in 6 a combination of intrauterine and external radium treatment was given.

These results show that irradiation is more dangerous and less effective in adeno-epithelioma of the body of the uterus than in epithelioma of the cervix. The lack of effect is due largely to the fact that these cancer cells are not very sensitive to irradiation. But the cell changes seen in some cases after irradiation and the disappearance of the tumors in some of the cases suggests that better results may be obtained with improvement in technique; but until a technique has been devised that gives as good results as those obtained in epithelioma of the cervix the author thinks it advisable to operate in this class of cases.

Lahm, W. Radium irradiation in the treatment of carcinoma of the cervix. *Strahlentherapie*, 1929, xxxiii, 97–119.

Details of the methods of irradiation used at the Dresden, Paris and Stockholm Radium Institutes are reported and diagrams given showing the distribution of the irradiation and the lines of iso-dosage. Statistics are also given for the cures at the three institutes in the different stages of carcinoma of the cervix with different dosages. The same percentage of carcinomas of Groups II and III were cured by the Paris and Stockholm methods so it may be assumed that the same biological dose is given by the two methods. Calculated in milligram-hours the amount given at 5 cm. depth is quite different by the two methods. The Paris Institute irradiates for five successive days (120 hours) and attains a dosage at the wall of the pelvis of 3×120, or 360 mgh/cm. The Stockholm Institute irradiates for 60 hours with intervals of one and two weeks, so does not reach more than 3×60, or 180 mgh/cm. As the results are the same it would seem that when the dosage is divided the biological action on the carcinoma is greater. This conclusion agrees with the biological results obtained in the irradiation of ascaris ova.

No matter what interpretation is given the facts they show that destruction of carcinoma is dependent primarily on the dose given. Destruction of carcinoma of the cervix requires a dose of about 500 mgh/cm., equal to about 110 per cent of the skin erythema dose. It may be a little lower than this if the irradiation is given in divided doses. But there are doubtless a considerable percentage of cases in which higher dosage is indicated. The author's results have shown that these higher doses do not impair processes of healing in the mesenchyme.

Mandarino, A. Roentgen treatment of malignant granuloma. *Arch. di radiol.*, Jan.-Feb., 1929, v, 202–219.

Various medical treatments have been tried in malignant granuloma without much effect. Arsenic is the best of them. But the only really effective treatment is roentgen irradiation, and while it cannot be said to cure it brings about great improvement and prolongation of life.

The author describes 2 cases which he treated. In the first case he made three applications of the rays, two in front and one behind, with a filter of 0.5 mm. Cu and 2 mm. Al, spark gap 38 cm., 6 H at a treatment. This resulted in improvement in the general condition, disappearance of the fever, improvement in the blood picture with increase in erythrocytes and hemoglobin and decrease

of leucocytes to normal values and great decrease in the size of the enlarged glands. In the second case he gave 5 H at a treatment with a spark gap of 44 cm. and a filter of 4 mm. Al; on Sept. 7 he irradiated the right inguinal region, on the 11th the left, on the 18th the right again. The swelling of the glands disappeared, there was improvement in the blood picture, fall of fever and improvement in the general condition. This patient had a recurrence in a year but the immediate effect was remarkable.

v. MIKULICZ-RADECKI, F. Treatment of carcinoma of the uterus at Stoeckel's Clinic. *Strahlentherapie*, 1929, xxxiii, 120–130.

Stoeckel's clinic has been dissatisfied with its operative results, for not more than 20–30 per cent of the women with carcinoma of the cervix have been saved, that is one in every 4 or 5. The figures for relative cure are deceptive for they apply only to operable cases, while the number of inoperable cases is so high as to bring the figures down to those given above. So for the past six months they have been using a combined method. Every carcinoma of the cervix, no matter to which group it belongs, is first given a radium full dose of 6000–7000 mg.-hr. in two treatments with an interval of three weeks between. The radium is filtered through 2 mm. brass and is placed in the uterus and partly in front of the portio. The vaginal radium carriers are fixed with paste and the bladder and rectum protected by lead plates. Six weeks after the irradiation the carcinomas that were operable in the first place are operated on by vaginal total extirpation of the uterus; the ones that were at first inoperable are operated on as soon as they become operable. After the operation radium carriers are put in the wound bed in the parametrium; they are placed in specially constructed glass drains and kept from the adjacent tissues by a layer of paraffin about 8 mm. thick. This gives the parametrium a dose of 300 to 400 mg-hr. At the end of convalescence the patient is given an intense roentgen irradiation of the pelvis. In very bad cases with infiltration of the parametrium radium needles are inserted in the parametria at the second treatment; the needles contain 2–4 mg. radium element and are left in twenty-four to forty-eight hours. The dosage and number of needles depends on the individual case. And the cases that are at first inoperable are given a full roentgen dose immediately after the first radium treatment and about eight weeks later a second roentgen irradiation but with small fractional doses. Recurrences after operation are treated with radium and roentgen irradiation, particularly radium needles inserted into the nodules. At least the temporary effects on the recurrences have been good.

The object of the preliminary irradiation is to overcome suppuration of the tumor and so give better chances for successful operation, to render inoperable carcinomas operable and to affect even operable ones to such an extent that the operation can be carried into normal tissue. Some illustrative cases are described showing the good effects of the preliminary irradiation. The object of the irradiation after the operation is to destroy any carcinoma tissue that may not have been removed by the knife.

In carcinomas of the body of the uterus the results of operation are so good that they dispense with the preliminary irradiation but not with the postoperative treatment. Inoperable cases are of course treated with radium and roentgen rays but the results in these cases are very bad.

The late results of the method will of course have to be determined later but in principle it makes use of the good results of both operation and irradiation.

MILLER, RICHARD H., and SHEDDEN, WILLIAM M. Tuberculous cervical adenitis. *Am. Rev. Tuberc.*, May, 1929, xix, 511–528.

A general résumé of the present-day methods of treating tuberculous cervical adenitis is given. General hygienic measures, heliotherapy, and rest are essential in all cases. Tuberculin is of doubtful effectiveness but may help in some cases. Ultraviolet light is of value in building up local resistance and in the healing of tuberculous sinuses. The roentgen ray is, as Hanford has shown, very valuable and must be accepted as an important method of treatment.

An analysis of 204 cases in which some form of operation was performed is given. Follow-up records were obtained in 132 cases. Satisfactory results were obtained in 78 per cent.

Special stress is laid upon the fact that tuberculous lymph nodes contain living tubercle bacilli that have been, are being, and will be liberated into the general circulation. From such nodes the disease may be spread as a mild bacteriemia to the various organs of the body. These facts must be considered in adopting any form of treatment. Because radical operation removes these foci of infection, the authors consider surgery the treatment of choice in tuberculous cervical adenitis.—*E. P. Pendergrass.*

Morson, A. Clifford. Observations on twenty-three cases of carcinoma of the bladder treated by radium. *Brit. M. J.*, June 8, 1929, i, 1038–1039.

The consensus of opinion on the Continent appears to be that malignant disease of the genito-urinary organs, apart from the penis, reacts unfavorably to radium treatment. The author reports 23 cases of inoperable carcinoma of the bladder observed since 1925 and treated by buried radium needles. All cases before treatment was commenced were profoundly ill from sepsis or profuse hemorrhage. Three died within one month, 2 lived three years, one lived two years, and 2 treated in 1927 are alive; one dead. In 1928, 15 cases treated; 10 are under observation, 5 are dead. The technique was as follows: Suprapubic cystotomy, 5 mg. needles of radium element in threaded platinum tubes, 25 mm. in length, 0.5 mm. platinum filter, are inserted 2 cm. apart on the mucous surface and the external aspect of the tumor. The needles are left in place for twelve to twenty-four hours, and are then withdrawn through the cystotomy opening.

The general state of health improved in almost every patient, and an increase in weight was noted in every patient for six months after the treatment.—*E. P. Pendergrass.*

Muir, Joseph. Radium treatment by the implantation of screened seeds. *Lancet*, July 6, 1929, ii, 7–11.

Muir discusses the advantages of the screened seeds. He states that by using very minute quantities of radon in each seed the amount of surrounding necrosis can be greatly reduced, but never entirely eliminated. Gold seeds as used in the United Stares when compared with the glass covered seeds have several drawbacks in their use, one being the danger of leakage from an imperfectly sealed tube, this leakage resulting in a greater degree of necrosis, and another is the "chisel like" ends left on each seed by the method of separation with pliers. Not only are these sharp ends likely to induce unnecessary trauma as they are introduced, but it is quite impossible to use them under many conditions as there is no way in which they can be recovered, and they must thus remain as an irritative foreign body in the tissues in which they were used for the purpose of treatment.

The radon seed consisting of a perfectly tight glass tube enclosed in platinum is superior to the gold because of its insurance against leakage and the absence of irritation from the rough ends.

Muir briefly describes the use of the seeds in malignancies of the mouth and throat. They are especially well adapted for use in lesions situated far back on the dorsum of the tongue where needles cannot be kept in place. For lesions at the root of the tongue and the floor of the mouth, as well as those in the tonsil and larynx, implantation can be successfully accomplished from the outside thus doing away with any danger from infection of the attached threads by the mouth secretions. In the esophagus the dangers from tissue necrosis are perhaps greater than any other area wherein radium therapy has been tried.

In gynecological cases it is now possible by the use of seeds to implant the highly friable tissues infiltrated by advanced carcinoma, and to remove the seeds after a suitable exposure, without inflicting any trauma upon the carcinomatous area. In these cases the intolerable pain rapidly subsides, foul-smelling discharge is lessened or ceases altogether and elimination of the toxic focus polluting the blood stream permits a marked improvement in the patient's general condition: The malignant area cleans up in a short time to such an extent that it is possible to make use of the more regular means of employing radium, implantation of needles, etc. In dealing with vesical neoplasms in both sexes the implantation of screened seeds has found one of its greatest fields of usefulness. He recommends the method of Eisendrath and Rolnick for implantation of seeds in cases of malignancy of the bladder by use of the cystoscope. The method for implantation of seeds in treating malignancy of the prostate either through the perineum or by the suprapubic route is described.

The simplicity and accuracy which are among the most salient features of this technique have greatly extended the field of usefulness within the bounds of which radium has been in the past so closely restricted. The paper is illustrated with numerous drawings describing the technique of implantation in the various areas.—*R. S. Bromer.*

Panton, P. N., and Valentine, F. C. O. Chronic lymphoid leukemia. *Lancet*, May 4, 1929, i, 914–916.

The leucemias are commonly divided into the myeloid and lymphoid types and each type is subdivided into the acute and chronic forms. This presentation is concerned with chronic lymphoid leucemia, associated with enlarged lymph nodes, enlarged spleen, anemia, and increase in the white cells, with a high relative increase in the lymphocytes.

It is difficult to distinguish between primitive myeloblasts and primitive lymphocytes.

Leishman's stain has been relied upon. When the small lymphocyte predominates, the typical cell shows a very small amount of clear blue cytoplasm around the nucleus. Irregularities and primitive cells were frequently found. When the large cells predominate, few cells show azure granules and many show fairly deep blue cytoplasm. The nuclear meshwork is coarser than the adult lymphocyte. A few have a greenish-blue cytoplasm and nuclear network is even.

Etiology. Twenty-five cases of chronic lymphoid leucemia were seen at the London Hospital from 1912–1917. During the same period, 89 cases of chronic and 58 of the acute myeloid leucemia have been observed. Twenty of the 25 cases of chronic lymphoid leucemia occurred in men, and 5 in women. The average age incidence was fifty-five years. Of the 25 cases, 9 were Hebrews, 13 were non-Hebrews, 2 uncertain. The ratio of Hebrews to non-Hebrews treated in London Hospital is approximately 1:10.

Course and Symptoms. The average duration in 21 cases was 2.17 years, the series including one woman who lived seven years and a man, six years. The lymph glands were enlarged in all cases except one woman. The spleen was enlarged in 20 cases, but in only 4 did the lower pole extend below the umbilicus. In 15 cases, lymph gland enlargement was the early symptom, especially in the cervical region, and 4 had abdominal swelling as an early symptom.

In 19 cases, the predominant cell was the small lymphocyte and in 6 the large. The average count with the large cell was 66,000 and the average in the small cell was 208,000. Anemia was present in all cases at some time, but 14 had counts at times of 5,000,000. The color index was that of a secondary anemia.

Treatment. Arsenic was given by mouth and roentgen therapy over the spleen and enlarged glands. The treatment has been symptomatic and is not curative. Too much treatment is to be avoided.—*E. P. Pendergrass.*

PECK, GEORGE T. The management of intra-oral cancers at the Radium Institute of the University of Paris. *Ann. Surg.*, July, 1929, XC, 15–25.

The purpose of this paper is to report the technical details and principles involved in the management of intra-oral cancers at the Radium Institute of the University of Paris, together with personal observations, impressions, and comments.

A biopsy is performed upon every tumor as soon as the patient presents himself at this clinic. If the tumor has been treated by radium or roentgen radiation elsewhere the patient is not ordinarily eligible for admission to the clinic. This is for the purpose of bettering the existing methods of cancer treatment and to establish a rational scientific basis for radium therapy. The statistics of the Radium Institute indicate that the efficiency of the radiation treatments diminishes rapidly with their increasing number. An improper first treatment may render a neoplasm incurable by radiatoin. Regaud believes that the roentgen ray is not successful after radium has failed. On the contrary, recurrences after roentgen irradiation are occasionally susceptible to radium treatment. When association of the two modes of irradiation is purposely planned, it is advisable to have the roentgen therapy always precede the treatment by radium.

The following localization of lingual cancers has been adopted at the Radium Institute for several reasons. The cancers peculiar to these regions have significant variation in histologic structure; they are endowed with different biological qualities and behavior characteristics; the treatment of each group constitutes a different radiological and surgical problem.

The regional classification of cancers of the tongue: (*a*) the dorso-lingual anterior area—"pars anterosuperior linguae"—situated anterior to the lingual v, formed by the vallate papillae; (*b*) the dorso-lingual posterior area—"pars posterosuperior linague"—situated behind the lingual v and extending into the fauces and hypopharynx; (*c*) the inferior lingual area and the floor of the mouth—"pars infralinguae."

Histologically, the comparative malignancy of the lingual cancers ascends in the following order: dorso-lingual anterior cancer, infralingual cancer, dorso-lingual posterior cancer. The exophytic papillary cancers are less malignant than the ulcerative, infiltrative cancers of the same location. For many years Regaud and Lacassagne have graded the histological characteristics of tumors in a manner similar to the method which has become recently popularized as "Broder's index of malignancy." In their conservative way they do not attach undue significance or value to this finding, because of the observation that in some instances biopsies from different parts of the same tumor may show several different degrees of cellular differentiation.

The French school distinguishes between two types of differentiation or cellular evolution of epidermoid carcinomas, namely a cutaneous and a mucous membrane metamorphosis. Both types occur among the intra-oral group of cancers. In the dorso-lingual posterior and

the infra-lingual areas the cutaneous type of epidermoid carcinoma is quite uncommon. The lympho-epithelioma of Regaud is a tumor of interesting nature. It occurs frequently in the tonsil and the base of the tongue. These epitheliomas usually produce voluminous lymphadenopathies while the primary lesion is barely discernible. Histologically and biologically it is a very malignant tumor.

The comparative radiosensitivity of the lingual cancers ascends in the following order: dorso-lingual anterior cancer, infralingual cancer, dorso-lingual posterior cancer. Cells are particularly radioresistant when for a long time they have been in a state of repose or rest and are most sensitive to radiation when they have been in a state of mitosis or indirect cell division. Regaud believes that a short irradiation will destroy only those cells which at the moment are in a state of their maximal radiosensitivity. It spares the others. On the contrary, a longer irradiation for several days destroys all the mother cells successively, because, as the cycle of cellular renovation continues, each cell passes at some time into the phase of maximal sensitivity. He believes that the majority of epidermoid carcinomas are not more radioresistant than the epidermis from which they are derived. For the most part the cancers are less radioresistant. The dosage for sterilization of cancers of the lip, mouth, and pharynx is from 70 to 100 per cent of the epidermicidal dose. The radiosensitivity of intra-oral cancers is diminished by infection and this is particularly dangerous in the infra-lingual region. Immunization or radio-vaccination of the neoplasm results in acquired radioresistance from the administration of improperly repeated and spaced irradiations. The predominance of polyhedral cells of the same type as the cells of the malpighian layer of the normal cutaneous epidermis indicates relatively feeble radiosensitivity, as these cells are usually in the evolutionary course of keratinization. In general, it may be said of the radiosensitivity of epidermoid carcinomas that differentiation of the cutaneous type coincides ordinarily with feeble radiosensitivity, whereas the type mucosae of the same relative degree of differentiation is more highly radiosensitive.

In America the dosage of radium is expressed in terms of "milligram-hours" or millicurie-hours," which is a constant value, being the dose of emission. The dosage notation used throughout France makes the dose proportional to the quantity of radium destroyed during the course of its application. This notation is preferable because it is commodious and equally applicable to tubes of radon or of radium. Before treatment is started the teeth are thoroughly cleansed, the necessary dental extractions are performed and pyorrhea treated. During the course of the treatment the mouth is cleansed daily with irrigations of saline or potassium permanganate solution. While radioactive foci are in the mouth, gauze is interposed between the teeth, tongue and cheek for the purpose of avoiding the influence of secondary radiations given off by the teeth. Peck describes fully the technique employed in the Institute, which cannot be described at length for abstract purposes. The tubes employed give a cylinder of irradiated tissue rather than a sphere, such as occurs with the use of radon seeds. Under regional anesthesia the needles are introduced into the tongue and completely buried there. It is important that the buried needles are parallel with each other. Furthermore the needles must be at a distance of one centimeter or more apart from each other in order to prevent possible necrosis from too heavy radiation and from secondary rays flying from adjacent needles.

Regaud's principles in the treatment of lingual malignant disease are: (1) To distribute numerous and weak radioactive foci in the whole cancerized part and immediately around, having care to create a radiation field as homogeneous as possible; (2) to use the gamma rays only in order to avoid a necrotizing effect; (3) to give a continuous irradiation for a long time, reducing thus both the intensity and the dose; (4) to expect success from but a single treatment, in order to avoid auto-immunization of the neoplasm against radiations.

The principal causes of failure in this method of radium puncture of the tongue are recited by Regaud as follows: (1) A too narrow estimation of the cancerized place; (2) the want of accuracy, especially in the places difficult to reach (e.g., in the pharyngeal part of the tongue); (3) an insufficient global (total dose), or too much inequality in dealing out of the dose given out by the different needles; (4) an imperfect material of the needles; (5) radionecrotic accidents.

According to Regaud, radionecrosis is caused by: (1) The excess of the global (total) dose; (2) the excess of the dose in a limited area, resulting from a few needles being wrongly placed; (3) the repetition of the treatments; (4) a too weak screening; (5) the simultaneous association of radium puncture and of strong irradiation from an external source.

Dorso-lingual Anterior Cancers. By virtue of their accessible location and anatomy these cancers are easy to treat by irradiation, and

radium puncture or interstitial irradiation is regarded as superior to the surgical extirpation of such cancers. Very small ulcerations of the tongue, of which the clinical diagnosis is uncertain and of which biopsy is practically equivalent to the total removal are left to surgery. If the lingual cancer is operable and a previous attempt to cure it by radium has failed, then the tongue should be amputated, because of the less efficacy of each successive radium treatment.

Dorso-lingual Posterior Cancers. These cancers are difficult to treat by interstitial irradiation because of their position. Some of these lesions descend very deeply into the pharynx and are poorly treated by radium puncture alone; some of the cancer cells frequently remain viable if not unscathed, hence supplementary external irradiation at a distance should be given over the superior part of the neck.

Cancers of the Infra-lingual Area and the Floor of the Mouth. Even when extremely small, cancers of this region are seldom removed successfully by surgical means. In recognition of this, the technique at the Radium Institute has been to apply topical or surface irradiation to the superficial carcinomas of the floor of the mouth anteriorly. In suitable cases with little infiltration an apparatus in the nature of a wax moulage is moulded directly and applied to the floor of the mouth; during this procedure the tongue is protected by a lead sheet. Radium puncture of the floor of the mouth frequently causes radium necrosis; another dangerous complication is the occasional development of phlegmonous inflammation of this area. In those infra-lingual cancers where a progressive cancerous infiltration into the deep muscles of the tongue occurs, an intratubal moulage would be insufficient; in such an event, interstitial irradiation of the infiltrating tumor must be performed. Interstitial irradiation is carefully avoided when the carcinoma involves the mucous membrane covering the inferior maxilla. Such a region is treated by the application of radium on a mould, or if this is unsuccessful, the maxilla is resected and the site later irradiated by external radium therapy at a distance.

Cervical Lymphadenopathies. The frequency and promptitude of invasion of the cervical lymph nodes occur in the following order of ascendency: dorso-lingual anterior cancers, dorso-lingual posterior cancers, infra-lingual cancers. Cancerous lymphadenopathies follow cancers of the lingual and sublingual areas with greater frequency than obtains for labial cancers, and infiltrating carcinomas are more precocious in their metastases than the papillary types. Lymph nodes involved from cancers of the tongue occur deeply while those from lesions on the lip are more superficial and more easily perceived. If there are palpable adenopathies in the neck, they are not molested until after the radium reaction in the tongue has subsided (a period of about three weeks). Then a unilateral block dissection of all the cervical lymphoid tissue is performed; very seldom are both sides subjected to operation. Every lymph node is examined histologically; if found to contain carcinoma, the neck is irradiated by radium therapy at a distance. If no microscopic evidence of carcinoma is discovered in the excised lymphoid tissue, then the neck is not irradiated, but careful watch is observed.

Neck Dissections. These are not performed at the Radium Institute if the general state of the patient is bad, when the lingual cancer is very tiny, when there are no perceptible adenopathies in patients who are under constant surveillance, and when the cervical lymph nodes are voluminous and so fixed as to render surgical removal dangerous to the patient. In the latter case Regaud believes it worth while at times to remove surgically the greatest part of the tumor, because its large size is one of the contributory factors in the failure of radium therapy. External radium therapy always follows the surgical act.

Irradiation of the Neck. At the Institute it is agreed that postoperative radium therapy has increased the efficiency of the surgical dissection. External radium therapy at a distance rather than roentgen ray treatment is the method of choice for irradiation of the neck. A wax case or moulage is made for each patient's neck. External and bilateral radium therapy and roentgen therapy of the superior part of the neck frequently produces a disagreeable but temporary radio-epithelitis not only of the mouth but of the pharynx. Doctor Regaud has not persevered in the practice of transcutaneous radium puncture of the lymph glands of the neck, nor of putting radioactive foci in the lymph nodes after exposure by a surgical incision. He has warned radium therapists that radium therapy by external foci must never be practised together with radium puncture, because of radionecrosis which may result from secondary radiation arising from the heavy metal of the needles.

Cancers of the Lip. Lip cancers receive irradiation from three sides by the surface application of a wax moulage in whose superior surface the radium tubes are implanted. In the case of labial cancer where no palpable lymph nodes exist, examinations of the neck

are made preferably by the same doctor who treated the lip. The patient is examined every two months during the first six months, then every three months until the end of the second year, then two times during the third year. If palpable adenopathies are present, the management is the same as previously described in tongue cancers. Postoperative radium therapy is again preferred to roentgen therapy.—*R. S. Bromer.*

Pordes, Fritz. Changes in the course of acute inflammations after roentgen irradiation. *Strablentherapie*, 1929, xxxiii, 147–151.

When acute inflammatory conditions are irradiated there may or may not be a temporary exacerbation, and the cure, when it is brought about, may be in the form of a simple retrogression of the inflammation or suppuration may be hastened and the general course improved. In the second form the abscesses that form after irradiation do not show the symptoms of spontaneous abscesses. These abscesses must be evacuated like spontaneous abscesses and the clinical picture of abscesses after irradiation must be known, for most of the failures in the roentgen treatment of acute inflammations, provided the proper dosage is used, are not due to failure of the action of the rays but to failure to recognize and open such abscesses.

Prusciano, F. Roentgen treatment of psoriasis by irradiation of the skin and indirect irradiation. *Arch. di radiol.*, Mar.-Apr., 1929, v, 452–456.

For some time the author treated psoriasis by irradiation of the skin and often had good immediate results but there was always recurrence. He finally had a family in which the parents and three children had psoriasis and this suggested that the psoriasis was due to disturbance of endocrine function and since then he has been giving indirect irradiation of different endocrine glands instead of direct irradiation of the skin, with much better results. Among a group of 35 cases 13 were treated by irradiation of the skin; temporary improvement; recurrence; 9 by irradiation of the thyroid and testicle with 3 improvements and 6 cures; 1 by irradiation of the testicle with cure; 4 by irradiation of the hypophysis and ovary with cure; 4 by irradiation of the thyroid and thymus with 3 cures and 1 improvement; 5 in patients with chronic malaria by irradiation of the thyroid and spleen with 3 cures and 2 improvements. Another series of 10 patients treated since has confirmed him in his opinion that psoriasis is due to endocrine disturbance and should be treated by irradiation of the endocrine glands.

Schönig, A. Effect of roentgen irradiation on the reticulo-endothelial system and its relation to roentgen sickness. *Strablentherapie*, 1929, xxxiii, 55–69.

The effect of therapeutic roentgen irradiation on the reticulo-endothelial system was studied by means of the Congo-red method. There was a decrease in function of the reticulo-endothelial system immediately after irradiation with castration and carcinoma doses. It was found that the height of the Congo-red index and the intensity of roentgen sickness ran parallel. If the reticulo-endothelial system absorbed the stain poorly, the sickness was more intense. If absorption of the stain was good there was no roentgen sickness. Apparently the absorptive capacity of the reticulo-endothelial system for Congo-red corresponds to its capacity for absorbing tissue toxins. Roentgen sickness is a symptom of intoxication of the body by products of disintegration of cells. Its intensity is dependent on the amount of products of disintegration produced by the action of the rays and the capacity of the reticulo-endothelial system for absorbing them. As roentgen sickness is an evidence of serious changes in the defensive forces of the body it should be avoided as far as possible. This can be accomplished by dividing the therepeutic dose into several fractional doses.

Stacy, Leda J. Carcinoma of the fundus of the uterus. *Surg., Gynec. & Obst.*, July, 1929, xlix, 43–47.

The author calls attention to an increase in the incidence of carcinoma of the fundus of the uterus, which has been noted by various writers. The same factors that play a part in the increase of carcinoma in general apply to the increase of carcinoma of the fundus of the uterus, namely: (1) Increase in life expectancy, bringing a greater number to "cancer age;" (2) increased knowledge among the laity of early symptoms of carcinoma of the uterus, and (3) the more frequent examinations of the pelvis and the more accurate diagnoses made by the family physician.

From a study of 333 cases of carcinoma of the fundus of the uterus in which operation was performed at the Mayo Clinic between the years 1907 and 1923, the author concludes that, although carcinoma of the fundus occurs most commonly after the menopause, it is fairly common in women less than forty-five years of age, this having occurred in 10.51 per cent of the series reported.

Uterine myoma occurs more than three times as often in women with carcinoma of the fundus of the uterus as in women without the latter condition. The symptoms of carcinoma of the fundus of the uterus, abnormal vaginal discharge, metrorrhagia, and watery discharge, are often masked by myoma, thus delaying the diagnosis of malignancy. It would seem that polypi of the fundus, like those of the rectum, are prone to become malignant, while polypi of the cervical mucosa rarely undergo carcinomatous change.

The author feels that every patient having metrorrhagia or an abnormal vaginal discharge should be examined thoroughly to determine the cause, irrespective of age, and if the symptoms warrant it and the patient is not a poor surgical risk, hysterectomy should be done, even if malignancy is not found by curettement.

In the series reported, the greatest number of the patients who died following operation for carcinoma of the fundus, died during the first three years of local recurrence. A number of patients had recurrence after the fifth year, so it is suggested that the term "five-year arrested cases" be used rather than "five-year cures."

A consideration of the data found in Table II results in the author's statement that more five-year arrested cases result from operation for carcinoma of the fundus of the uterus than from operation for carcinoma in other commonly affected organs.—*E. P. Pendergrass.*

MISCELLANEOUS

ACKERMANN, W. The treatment of tuberculous pericarditis with effusion by injection of air and lipiodol into pericardial sac. *Am. Rev. Tuberc.*, August, 1929, xx, 236–242.

A case of tuberculous pericarditis with effusion is reported in which the treatment consisted of the withdrawal of the pericardial effusion followed by the injection of air. On one occasion lipiodol was injected. During a period of 6 months the pericardium was tapped 20 times, 17 of these were followed by the injection of air. There was an immediate and progressive improvement in the patient's condition following the institution of this form of treatment. From his experience in this case the author feels that the following observations are warranted: (1) The performance of artificial pneumopericardium is without danger and discomfort. (2) The injection of air gives greater relief than does the aspiration of the exudate alone. (3) The presence of air delays the reformation of exudate. (4) By holding apart the two layers of the pericardium the friction rub and formation of adhesions are prevented. (5) On roentgen examination the air in the pericardium permits one to see how completely the exudate has been evacuated. (6) The injection of lipiodol sets up an irritation, with elevation of temperature, and this seems to have a great effect in reducing the vitality and the number of tubercle bacilli.—*E. P. Pendergrass.*

ARNONE, GIOACHINO. New bases for a clinical physiopathology of the skeleton. *Radiol. med.*, Aug., 1929, xvi, 805–807.

According to the views of the old physiologists and even the early roentgenologists, the skeleton was simply the result of two processes: apposition and absorption of bone. And all diseases of bone were thought to be due to a disequilibrium in these two processes. The author says this is just as great a mistake as to think that the whole life of the individual consists of earning and spending. The life of the individual and the life of bone are much more complex than that. The skeleton is a plastic system that has a life of its own. It has a biological determinism which is in harmony with the constitution of the individual. It is not merely a tissue for protecting the other organs but is a true system just as much as the circulatory or nervous system. The roentgenologist should not study the skeleton simply from the point of view of deposition and absorption of calcium salts but as a manifestation of the morphological, physiological and psychic individuality of the subject; in studying it he should study disturbances in the function of all its cells and their relation to the other organs of the body.

BENASSI, ENRICO. Experimental roentgen study of the motor function of the gall-bladder and of the pharmacodynamic tests. *Arch. di radiol.*, Jan.-Feb., 1929, v, 117–146.

The author made a series of roentgenograms after treating normal animals with sodium tetraiodophenolphthalein and in this way studied the effect of different drugs and other methods of experimental treatment on the motility of the gall-bladder and on the excretion of bile. He found that drugs that stimulate the vagus, such as pilocarpin, muscarin, physostigmin, ergotamin and extract of hypophysis and electrical stimulation of the peripheral stump of the vagus in the neck, cause more or less marked contraction of the gall-bladder and as a result a more or less rapid flow of bile into the duodenum. But paralysis of the vagus by atropin causes dilatation of the gall-bladder and retardation of emptying

time. The results obtained by stimulation of the sympathetic with adrenalin are not as yet sufficient to prove definitely that this system has an inhibiting action on the contraction of the gall-bladder but they seem to indicate it.

BESSESEN, DANIEL H., and BESSESEN, ALFRED N. X-ray studies on the mechanism of labor with special reference to puerperal infection. *Surg., Gynec. & Obst.*, August, 1929, xlix, 220–227.

The purpose of this paper is to report the results of clinical roentgen-ray studies demonstrating the mechanism of labor, and the bearing this might have on infection.

Bacterial studies made before, during, and after labor show that 7 to 8 per cent of women have febrile reactions resulting from all labors. Zangemeister, and Harris and Brown have reported that bacteriological analyses made during cesarean sections show that six hours after the start of labor bacteria are in the uterus, but before the six hour period they are not usually present. The authors conclude, therefore, that this shows the action of labor has some bearing on the presence of bacteria in the uterus.

The progression and regression of the birth product during labor has often been observed and the possible retraction of the cervix has been suggested. The authors believe the cervical contraction normal. They felt that "if one could portray the relation between the cervix and the fetal head or presenting part during a contraction, and then again during the immediately following period of relaxation, any difference in the measure of distance between the cervix and the crown of the fetal head would represent the excursion of the birth product within the uterus."

Lipiodol was first injected but on the roentgenograms this failed to show the action within the uterus. Because of this a metal clip was inserted into the vaginal portion of the anterior lip of the cervix when dilated at 3 cm. This was done in 4 cases and shows the relation of the presenting part to the cervix. Twelve patients were studied and 6 had roentgen-ray studies.

A full history of the 4 cases is given. The first film was taken during contraction. Position, left occiput posterior. The clip was placed in the anterior lip of the cervix. The second roentgenogram was taken during the period of relaxation immediately after contraction shown in the first film. Comparative drawings were made showing the descent of the uterus into the pelvis and the motion of the presenting part within the uterus. The films were made in the middle left anteroposterior, right occiput posterior, and left occiput anterior positions.

Thus from the roentgenograms the conclusion is drawn that the mechanism of labor presents two relations, one between the uterus and pelvis, and one between the birth product and the uterine interior. There is the descent of the uterus within the pelvis during contraction and its ascent during relaxation.

The fetal presenting part makes an excursion within the uterus. This starts as an extremely small departure of the presenting part from the uterus and when dilatation becomes more marked the excursion of the fetus within the uterus becomes more marked. "The presenting part acts as a swab, smearing bacteria from the vagina onto the interior of the uterus," the authors state.

The spread of infection is also caused by manipulation or operative delivery at the time of parturition. This, in what the authors call an "uncomplicated case," delivered without accidents may still cause a fatal infection, which will develop from the action of the labor itself. Therefore, to all other causes of infection we must add that of the mechanism of labor itself.

The authors conclude by stating that every case of labor should be approached as a surgical operation and should receive an antiseptic preparation intravaginally early in labor.—*E. P. Pendergrass.*

CONTE, E. Study of the biological action of rays of different wave lengths. *Radiol. med.*, Aug., 1929, xvi, 790–805.

The author made a study of the antagonistic action of ultraviolet and infra-red rays on peptic ferment, diphtheria toxin and cultures of bacteria and did not find that the destructive action of roentgen rays was nullified or even decreased by a following irradiation with infra-red rays. He discusses his opinions in regard to the mechanism of action of rays of different wave length and comes to the conclusion that so far no satisfactory proof has been given that there is a true antagonism in a physical sense between these two types of rays.

CRAMER, H., and BORM, A. The new Metalix therapy tube. *Strablentherapie*, 1929, xxxiii, 156–159.

Two illustrations are given of this new tube which is a great improvement because of its simplicity and small size. The apparatus hangs down from the ceiling. The adjustment for height and depth is made by means of

two steel tubes, one of which glides inside the other, the inner one of which carries the cooling apparatus on a lateral arm and is balanced by a counterweight. The tube can be rotated through a complete circle; there is a wheel that can be manipulated by hand by which it can be turned from horizontal to vertical very quickly. Difficult adjustments, as for instance for a perineal feld, can be made very quickly. The irradiation tubes are made of thick lead glass and fastened directly to the tube. This mounting is made possible by the fact that the Metalix therapy tube has a broad metal girdle in the middle of it. There is a porcelain arm that carries a vessel that holds 4 liters from which water for cooling is carried to the tube through a rubber tube protected by metal. Filtration is automatic; if the filter is forgotten no rays pass out of the tube.

GIOVETTI, V. Statistics of the Roentgen and Physical Therapy Institute of the Hospital of Piacenza for the years 1926–1927. *Arch. di radiol.*, Mar.-Apr., 1929, v, 445–451.

This is a description of the organization and instrumentarium of the Institute and merely a numerical list of the different kinds of cases treated without any clinical or roentgen information in regard to them.

KUBO, HISAO. Experimental study of the effect of roentgen rays on the carbon and oxidation quotients in the urine. *Strahlentherapie*, 1929, xxxiii, 70–88.

The C:N and O:N quotients in the urine were both more or less decreased after irradiation of the whole body with roentgen rays (about 25–100 per cent of the human skin erythema dose); the degree of lowering depended on the dosage. But in the second week the values approached what they had been before the irradiation. Both quotients were also lowered on irradiation of the liver field with about 50–100 per cent of the human erythema dose. In one case with about 50 per cent of the erythema dose they were still low fourteen days after the last irradiation, while in the others with 100 per cent of the skin erythema dose they approximated the values before the experiment in the course of the second week. After irradiation of the lower extremities with 50–100 per cent of the erythema dose the two quotients were lowered for a few days but they approximated those of the preliminary period very quickly. Sometimes in the course of the second week or even the first there was a temporary rise in the quotients after a preliminary lowering. The changes in the quotients may be brought about by changes in the carbon and oxygen content of the urine as well as of the nitrogen, but it is chiefly a change in nitrogen that determines the changes in the quotients. On irradiation of the whole body or liver field the changes in the quotients were much greater than on irradiation of the lower extremities or the whole body excluding the liver fields.

Some of the experiments showed that irradiation with a certain dosage of roentgen rays causes a qualitative increase of oxidation but the author is unwilling to say from his results that irradiation with roentgen rays always causes a qualitative increase in oxidation. In 6 out of 8 experiments the oxygen in the urine was decreased by roentgen rays. There is a difference between the action of roentgen rays on the urinary quotients and that of ultraviolet light, radiothorium and radium bromide. The two quotients did not run exactly parallel after irradiation with roentgen rays but almost so.

LOVISATTI, N. The antagonistic action of rays on the skin. *Arch. di radiol.*, Mar.-Apr., 1929, v, 381–392.

The author reports experiments made to test the antagonistic action of ultraviolet and infra-red rays. In some cases the infra-red rays were applied first, in some the two kinds of rays were given together and in some the ultraviolet irradiation preceded the infra-red. He concludes that the antagonistic action of infra-red and ultraviolet rays on the skin is not due to physical or physico-chemical causes. It is due to anatomical and physiological reasons and results from the hyperemic action of the heat rays. This hyperemia, with the phenomena that accompany it, decreases the deep penetration of the actinic rays and defends the walls of the vessels and the cells of the interpapillary layer particularly. But this attenuating action of the hyperemia is not manifest unless the hyperemia is established before or during the ultraviolet irradiation. The attenuation is greater, the nearer the hyperemia is to the optimum of heat that lies between the maximum of vasodilatation and the minimum of cell lesions.

LOVISATTI, NICOLA. Study of secondary radiosensitiveness. *Radiol. med.*, Aug., 1929, xvi, 814–821.

In attempting to find methods of increasing the radiosensitiveness of the tissues to be irradiated, the author based his work on that of Spagnol on the fixation of colloids injected intravenously. In order to produce secondary

radiosensitiveness of a skin region he applied chloroform to the region in question for a little while and then gave an intravenous injection of colloidal mercury sulphide suspended in gelatin. In this way the colloid became fixed in the region to which the chloroform had been applied so that it constituted innumerable secondary sources of radiation. This is a preliminary note as the author so far has only used his method in rabbits.

Lowsley, Oswald S. A new cystoscopic-radiographic table. *J. Am. M. Ass.*, July 20, 1929, xciii, 194–195.

An effort was made to keep the cystoscopic-roentgenographic table as simple and inexpensive as possible. Those interested in this table should see the illustrations which show clearly how the table is constructed and used.

The table is 36 inches from the floor and has legs with 6 inch wheels at the head end, the other end having rubber feet to keep it immovable. A drain pan is fitted into the framework of the table, and a flat Bucky apparatus is fitted into the top of the table. The leg holders are constructed so that when fixed in position they are immovable. The knee rests may be made to swing about in a complete circle but may also be made immovable. The roentgen tube holder is so made that it may be placed where wished. The table is fitted with foot rests which are adjustable.

The entire table moves into a new position without any change of position by the patient.—*E. P. Pendergrass.*

Piergrossi, L. Matter and radiation. *Arch. di radiol.*, Jan.-Feb., 1929, v, 147–177.

For the purpose of giving medical roentgenologists a non-mathematical conception of the constitution of matter and the energy of the atom, the author reviews the history of the ideas and theories which led to the present conception of the atomic structure of matter, the number and weight of atoms, their electromagnetic nature and the creation of the idea of the electron and proton. As to the energy of the atom and the nature of radiation, especially roentgen radiation, he tries to give a logical conception of it based on Bohr's theory of the constitution of the atom and to materialize this conception by means of a model; he then explains the Compton phenomenon in diffuse irradiation, electron emission and the characteristic irradiation, by means of the quantum theory.

Waegner, Alfred. The prevention of roentgen sickness. *Deutsche med. Wchnschr.*, Feb. 22, 1929, lv, 316.

Levy-Dorn and Burgheim expressed the opinion that roentgen sickness is a result of a decrease in the cholesterin content of the blood. Burgheim later demonstrated that by peroral administration of cholesterin roentgen sickness may be prevented. Based on these investigations the Chemische Fabrik Grüaun, Landshoff & Meyer (Berlin-Grünau) prepared a cholesterin-lecithin mixture which they called "colsil."

The author used colsil in 72 of his patients (21 men and 51 women) in order to determine its effect on roentgen sickness. Two tablets were given previous to the irradiation and two immediately following the irradiation and this was followed up by the hourly administration of one tablet for two to four hours (the total dose thus being six to eight tablets). The results obtained were excellent. Especially impressive were the cases in which previous irradiations had produced marked roentgen sickness and in which no sickness whatever appeared following the administration of colsil.—*T. Leucutia.*

Warthin, Aldred S., and Pohle, Ernst A. The effect of roentgen rays upon the heart. II. The microscopic changes in the heart muscle of rats and of rabbits following a series of exposures. *Arch. Int. Med.*, Jan., 1929, xliii. 15–34.

In a previous article Warthin and Pohle came to the conclusion that the single exposure of the precordium to roentgen rays of the quality and quantity described in that paper, and corresponding to a human erythema dose, does not produce definite and irreparable injury to the heart muscles of adult rats and rabbits. The next step in these investigations suggested itself, i.e., the study of the effect of a series of exposures as they are carried out in the treatment of human beings. Their conclusions follow:

1. The precordium of 48 rats and 24 rabbits (leaving 2 or 3 in each group of 12 animals as controls) was exposed to roentgen rays (lambda effective equaled 0.16 and 0.23 Å respectively) three times at monthly intervals. The dose amounted to 600 R the first time and 300 R each the second and third times. The animals were killed from eight to thirty-two days following the last exposure and the hearts were examined microscopically.

2. In every animal irradiated, definite lesions were found in the myocardium, consisting

essentially of marked Zenker's necrosis and fatty degenerative infiltration. In many cases there was evidence of inflammatory reaction and early repair. These myocardial lesions were associated in every irradiated animal with a more or less severe bronchitis and bronchopneumonia and with other evidences of mediastinal roentgen-ray injury to the thymus, lymph nodes and ganglions. The authors regard the pulmonary infection as secondary to the irradiation injury of the bronchi, lowering the resistance and being followed by secondary bacterial infection. A vicious circle is therefore set up increasing the myocardial change.

3. They conclude, therefore, from these investigations that definite injury of the heart muscle results from a series of exposures as described. This suggests caution in any case in which the treatment brings the heart in the path of the rays.

4. An attempt will be made to define the threshold value of roentgen-ray energy for the lesions described, or in other words, the tolerance dose for the heart muscle.—*R. S. Bromer.*

WHITAKER, LESTER R. Problems in normal and in abnormal physiology of the gall-bladder *Arch. Surg.*, April, 1929, xviii, 1783–1802.

Knowledge of the physiology of the gall-bladder has taken great strides during recent years, but there is still much about this apparently simple organ that is baffling. The specific stimulus and the mechanism through which the contents of the gall-bladder are expelled into the intestines on demand have not been worked out thoroughly. The mechanism for concentration of bile in the gall-bladder through absorption of water seems simple, but other functions of the mucosa through which other materials are absorbed are not understood. Ordinarily during fasting, the gall-bladder is distended with concentrated bile which tends to become inspissated if the vesicle fails to empty. During this process varying amounts of mucus are secreted. Though one may assume that this mucus tends to prevent excessive inspissation or to act as a lubricant to facilitate the expulsion of the concentrated bile during digestion, there is no certain knowledge of its action. Furthermore, the question as to why the function of a gall-bladder which has been acting normally becomes so altered as to allow the formation of gallstones remains unsolved.

By the use of the cholecystogram in man investigators have shown that pure fat was most effective in rapidly emptying the gall-bladder, protein was much less effective and carbohydrates practically ineffective. Investigation showed this also to be true in the cat. Whitaker now believes that it can be said definitely that the contents of the gall-bladder are expelled chiefly by the contraction of its own musculature for the following reasons:

It has been demonstrated roentgenologically that muscular contraction can expel the contents of the gall-bladder: (*a*) by the expulsion of iodized oil after the administration of smooth muscle stimulants such as barium chloride; (*b*) by the evidence of contraction rings in the vesicle during the evacuation of its contents; (*c*) by the appearance of spasm in certain parts or the whole organ while it is emptying; (*d*) by the elongation of the gall-bladder during emptying and relaxation during rest; (*e*) by actual measurements showing a marked increase in pressure in the gall-bladder after feeding; (*f*) by noting in the exposed viscus contraction after feeding, with changes in shape and reduction in size, and (*g*) by the observation of peristalsis in the gall-bladder of a fish. Whitaker believes extrinsic factors as effective expulsive agents can be ruled out for several reasons such as pressure changes in the abdomen due to respiration which have no effect, intestinal peristalsis which has no effect, increased flow of bile from the liver after giving bile salts which causes no disappearance of the cholecystogram, and for several other reasons.

He believes the weight of evidence is against the theory that the expulsive action is reflex in character, although this has not been actually disproved. There is also little assumption for the belief that a reciprocal nervous mechanism exists whereby the gall-bladder is made to contract when the sphincter of the common bile duct is opened, in fact the chief evidence is against this. It also seems unlikely that fat in the circulation is the actual stimulus to motor activity of the gall-bladder, even though its ingestion hastens the emptying process. Experiments leave little doubt that some substance enters the circulation which stimulates the musculature of the gall-bladder, but the question still remains whether there is a specific hormone produced by the action of hydrochloric acid in the duodenum or otherwise. Apparently the origin and nature of the normal stimulus that initiates tonic contraction in the musculature of the gall-bladder resulting in the expulsion of its contents has not yet been determined.

The three normal functions of the gall-bladder are: (1) expulsion of its contents

through muscular contraction; (2) concentration of its contents through absorption of water, and (3) secretion of mucus. The beginning of disease in the gall-bladder must be sought in the multitudinous factors which influence the above functions, and in their interrelations.

Whitaker discusses the effect of overeating, infection, etc., on the normal functions of the gall-bladder, and concludes that through overeating, pregnancy, or conditions associated with rapid loss of weight, the cholesterol of the bile is increased; and that stasis in the gall-bladder is induced at the same time through functional disturbance or by infection, resulting in cholesterosis with the accumulation of debris in the gall-bladder. Conversely, it is possible that the cholesterol in the bile can be decreased by chance or by design, and that the functional disturbance or infection of the gall-bladder can be relieved, with the return of muscular power; and that then the debris if not too abundant or in too large masses, may be forced out of the viscus, with a return to normality.

It seems probable that if abnormal formation of cholesterol in the bile and its absorption by the mucosa should cease, the cholesterosis might be relieved eventually, either by vital activity of the mucosal cells or by desquamation and regeneration. Then the debris in the gall-bladder, if not in masses too large to pass the ducts, might be expelled by an active musculature. It may be that in patients gallstone formation actually begins, but its causes relieved, the viscus returns to normal. The development of a rational method for prevention of disease in the gall-bladder, and an effective method of early treatment depend on the expansion of knowledge concerning the normal and abnormal physiology of that organ.

This article is written in very clear and comprehensive fashion, and should be of great assistance and interest to roentgenologists, not only because of its lucid presentation of the problems in the normal and abnormal physiology of the gall-bladder, but also because of the very essential part that roentgenology is playing in the efforts to solve these problems.—*R. S. Bromer.*

Wright, Samson, and Bulman, H. A. Selective action of x-rays on the blood cells of the cat. *Lancet*, Aug. 3, 1929, ii, 217–219.

The authors studied the changes in the cells of the blood in the cat which follow exposure to heavy doses of penetrating roentgen rays. The entire body of the animal was irradiated at 57 cm. distance for varying periods, the spark gap being 10 cm. between spheres 5 cm. in diameter, 1 mm. of aluminum as filter. If the duration of the irradiation was 75 minutes or over, death invariably resulted within five to twelve days; with exposure of 60 minutes a proportion of the animals survived; if the period was less than 60 minutes practically all the animals survived. In their laboratory, it takes 150 minutes' exposure to roentgen rays of this type to kill, in vitro, the cells of Jensen's rat sarcoma.

The paper is illustrated by charts showing the effect on the red and white cells and the platelets. The authors' conclusions follow:

(1) The lymphocytes are decreased early and markedly.

(2) The polymorphonuclear leucocytes after an inconstant initial increase, decrease more slowly and sometimes to a smaller extent.

(3) Marked changes in the red cell count occur later still: (*a*) in fatal cases, an acute anemia develops in the final stages associated with evidence of hemolysis or the presence of widespread hemorrhages; (*b*) in non-fatal cases the anemia develops very slowly and recovery is similarly gradual.

(4) The blood platelets are apparently unaffected in the cases that have ended fatally within a short time of irradiation, even when there is evidence of infection. In cases that survive, the platelet count declines parallel with the fall in the red count, and then shows a gradual recovery.—*R. S. Bromer.*

X-ray films; methods of filing to prevent possibility of fire. *J. Am. M. Ass.*, May 25, 1929, xcii, 1763.

There are three problems in connection with the use of films in hospitals—the main file, the new films, and the current file. As a general rule, the current file is kept in an office, the new films in the dark room, and the main file in a separate room. Each of these presents a different hazard.

Unexposed films should be kept in lead-lined containers placed 2 feet above the floor, or in double-walled containers vented to the outside air. The amount of unexposed films in standard containers kept outside of standard vaults should not exceed 50 pounds.

When the current file is kept outside a fireproof vault, the number of films should be kept to a minimum and transferred to the main storage vault as rapidly as possible. The use of the safety film would not necessitate the above; they burn but do not explode; the only objection is their cost and the fact that they roll and curl.

APPROXIMATE WEIGHT OF FILMS

No. of Negatives	Size, Inches	Approximate Weight, Pounds
1000	14 × 17	118
1000	12 × 14	100
1000	10 × 12	60
1000	8 × 10	40

When more than 250 pounds of films are stored, they should be kept in a standard fireproof vault constructed as follows:

1. A film vault shall not exceed 750 cubic feet in actual capacity. The floor and walls shall be of brick at least 8 inches thick, or of reinforced concrete at least 6 inches thick.

2. A fire door shall be provided on each face of the wall to door openings leading into such vaults. Such doors shall be of the approved type. The interior and outside shall close automatically.

3. No skylights shall be permitted.

4. Shelves shall be preferably of noncombustible material. Aisle space shall be at least 3 feet wide. The height of the shelves shall be 2 feet below sprinkler deflectors.

5. Each store room shall be equipped with automatic sprinklers, each sprinkler head shall not exceed 64 feet of floor space.

6. An adequate vent to the outer air should be provided.

7. Heating should preferably be by hot water.

General Rules and Cautions. 1. A self-closing metal can should be provided for all waste negatives.

2. Stocks of unexposed films should be kept at a minimum.

3. Standard electrical fixtures should be provided in rooms where films are handled. The use of portable lights or extension cords should be prohibited.

4. Film negatives should be filed in heavy manila envelopes, and from time to time useless negatives should be weeded out.

5. Film illuminators shall be so designed that the diffusing glass is not hot to the touch.

6. Smoking shall be prohibited in all rooms where films are stored.

7. No films shall be stored within 2 feet of steam pipes, radiators, chimneys, or other sources of heat.

EDITORIAL. The hazard of toxic gases from combustion of roentgen-ray film. *J. Am. M. Ass.*, May 25, 1929, xcii, 1764.

The newspapers reporting the Cleveland catastrophe attributed the toxic effects to heavy brown fumes of bromine gas and various other toxic gases. The inflammable film is prepared from nitrocellulose and, as most chemists know, when the product explodes, carbon monoxide and nitric oxide are formed. Nitric oxide, even in air, quickly takes on oxygen and forms nitrogen dioxide (NO_2), or its polymer, nitrogen tetroxide (N_2O_4), the form in which it exists depending on the temperature.

Films contain silver salts, but it seems unlikely that enough stable silver bromide could be broken up sufficiently to yield bromine gas in anywhere near the toxic quantities reported, especially in the developed film.

There are two classes of films, inflammable and the noninflammable, or safety film. The latter does not contain the nitrated group. The disadvantages of the safety film is that it costs more and tends to curl and roll. The fire hazard of storing roentgenograms has been recognized for some time and in all hospitals special rooms and apparatus are provided for storing films, but these storage rooms vary from hazardous to safe conditions.—*E. P. Pendergrass.*

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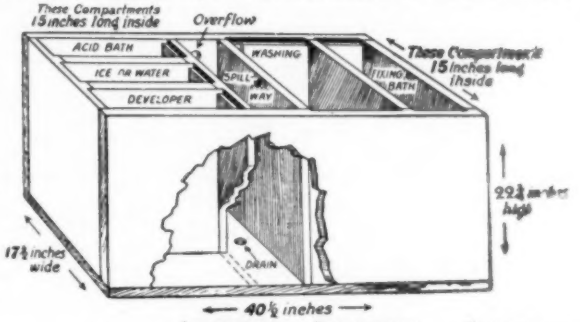

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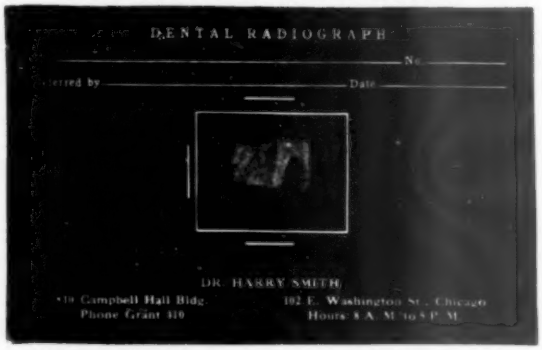

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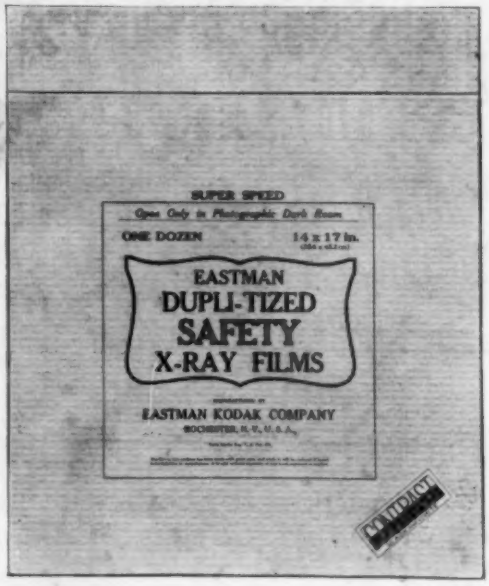

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